Engineering and Mining Journal

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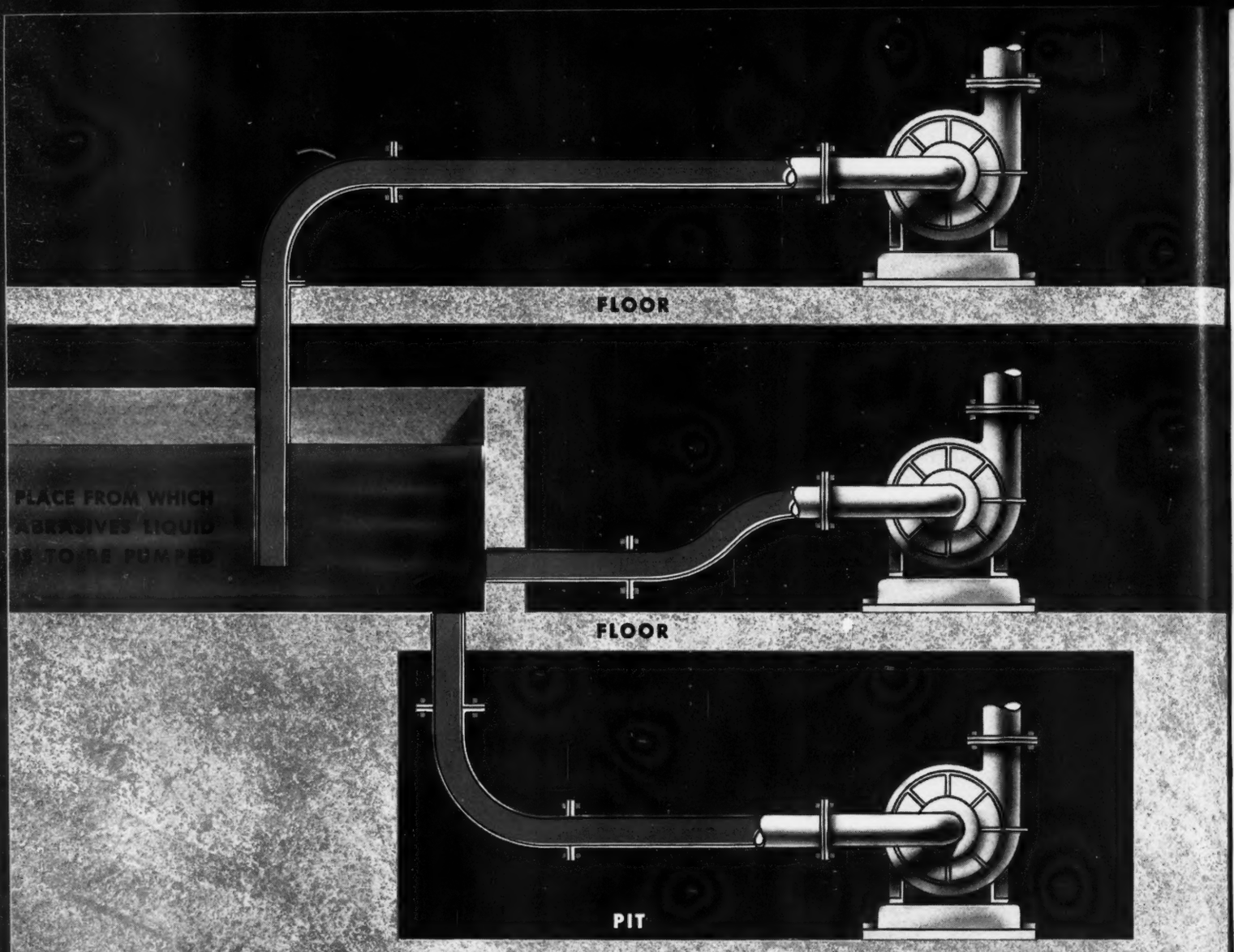

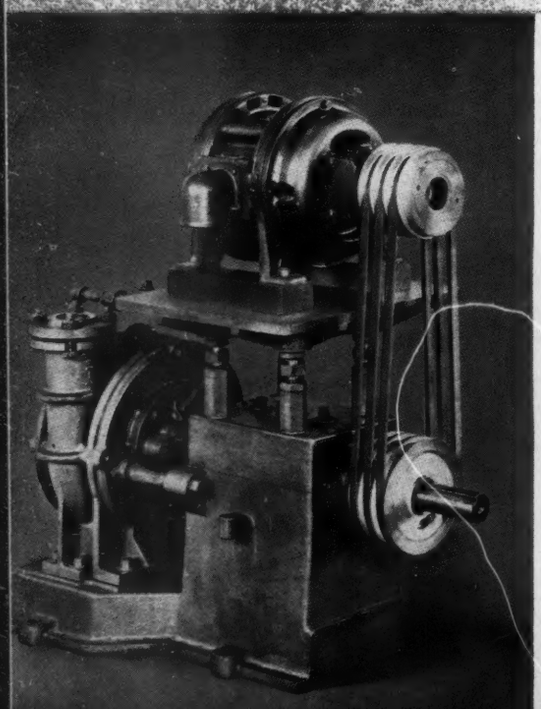

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SEPTEMBER 1938

The Idaho Maryland Decision

DECISION RECENTLY by the United States Circuit Court of Appeals that the National Labor Relations Act is not applicable to the Idaho Maryland Mines Corporation, and that the National Labor Relations Board therefore had no jurisdiction to issue its order of January 10 last, requiring the company to desist from alleged unfair labor practices "affecting commerce," has much interest for mining companies that are doing business wholly within a single State. According to the Court, the Board's jurisdiction extends only to unfair labor practices affecting interstate and foreign commerce in the constitutional sense. The decision, reported briefly on p. 91 of *E.&M.J.*, August, 1938, declares that the Idaho Maryland activities are wholly intrastate—that "it buys nothing, sells nothing, ships nothing, and nothing is shipped to it, in interstate or foreign commerce."

The major facts regarding the Idaho Maryland's operations, as set forth in the decision, are briefly as follows: The company was and is engaged in gold mining in California, within which State the company also buys its supplies and equipment, some of this, however (to the extent of $125,000 annually), originating elsewhere. It does no smelting or refining, but ships most of its product—a "natural alloy" of gold and silver—to the United States Mint at San Francisco and the balance to the Selby smelter, on San Francisco Bay. The portion sent to the Mint is eventually shipped by the Treasury to the Denver Mint, this transfer being characterized by the Court, not as interstate commerce, but as an administrative act of the Government.

That mining is not interstate commerce the Supreme Court has held repeatedly; likewise, that mining is equivalent in its results to manufacturing, and that manufacturing must be completed before commerce begins. If therefore the Board was not desirous of gaining acceptance for a new interpretation of mining as commerce, or wishful that the Courts would ignore its wrongful claiming of jurisdiction, it must have based its hopes of retaining jurisdiction on the fact that the Idaho Maryland company bought some equipment and supplies originating outside the State and that its product eventually was transported out of the State. It is these two points and the Court's decision regarding them that deserve particular attention. Unquestionably, there are many companies now engaged in mining in a single State which have been laboring under the belief that there was no escape from the jurisdiction of the National Labor Relations Board, with its frequently high-handed and inequitable procedure. This belief, if it does not arise out of a deepset conviction that anything can happen under the New Deal, is doubtless due to the fact that these companies ship their products out of their respective States or else purchase supplies and equipment from without the State, or possibly do both. They may now entertain new hope.

As to the origin of supplies, the Court's decision declares expressly:

"There is no merit in the Board's contention that purchases by respondent, in California, of supplies and equipment manufactured in other States are so closely, initmately and substantially related to interstate commerce as to warrant the Board's assumption of jurisdiction in this case. Such supplies and equipment are not sold or shipped to respondent in interstate commerce. They are not sold or shipped by respondent in interstate commerce or at all. The relation, if any, between interstate commerce and respondent's purchases of supplies and equipment is indirect, remote and unsubstantial."

The Court's decision respecting the transport of the products of mining has already been dealt with.

In the event that this case is finally brought before the Supreme Court for review and is upheld, it would appear that every company operating within a single State will have opened to it an escape from the jurisdiction of the Board, provided it gives proper attention to the way it ships its product and buys its equipment and supplies. There is a right way and a wrong way of doing each of these things. A procedure here outlined, proposed by eminent lawyers, is worthy of attention. It is very doubtful that a mining company of the class cited could be held to be in interstate or foreign commerce so long as it takes the following precautions:

(1) To sell its product within the State, either by delivering it to a Mint, smelter, or refinery within the State boundaries or by selling it f.o.b its own mill or plant to a smelter or refinery elsewhere.

(2) To buy its supplies and equipment either from sales agents, representing manufacturers outside the

State, who call upon the mining company, take its order, and have the supplies and equipment shipped into the State marked for delivery to the mining company f.o.b. its plant or shipping point; or from a bona fide established factor or commission merchant who has the merchandise in stock or can obtain it from without the State. Use of the mails in ordering supplies from without the State should be avoided by the mining company.

Reversal of the recent decision, should it transpire, will in effect be equivalent to amending the Federal Constitution in transferring to a Federal agency powers now vested in the States.

Mexican Highlights

THE SIX MONTHS that have elapsed since the seizure of foreign-owned oil properties in Mexico by the Government of that country on March 18 have been marked by several things. Foremost in interest is the fact that mining has proceeded much as during the last three years, though with strikes on the whole somewhat fewer in number on the one hand and labor less willing to do a fair day's work on the other, the latter no doubt reflecting the Administration's anti-capitalistic attitude. Mine operators are with reason less concerned about the possibility of wholesale expropriation, though dismayed in recent weeks by the sudden imposition of a drastic export tax. Smelter production of the major metals for the period has not as yet been reported but is believed to compare rather more than favorably with that of the first three months. Silver producers now sell their metal on the open market instead of through the Government. The exchange rate has fluctuated, making difficult any planning in advance. The peso is now down to 20 cents from 28, surprising in that it has gone no lower.

Meanwhile petroleum output has fallen to negligible proportions, with enormous losses to the workers in wages and to the Government in revenue and with all the other financial evils, actual and threatening, that loss of confidence can precipitate. The economic picture is of the sort presented in the April issue, but with the hues much darker. Incipient revolution, real or staged, in San Luis Potosi in late spring was quickly squelched. Similar new efforts, if made, would cause no surprise, the condition of the country being what it is.

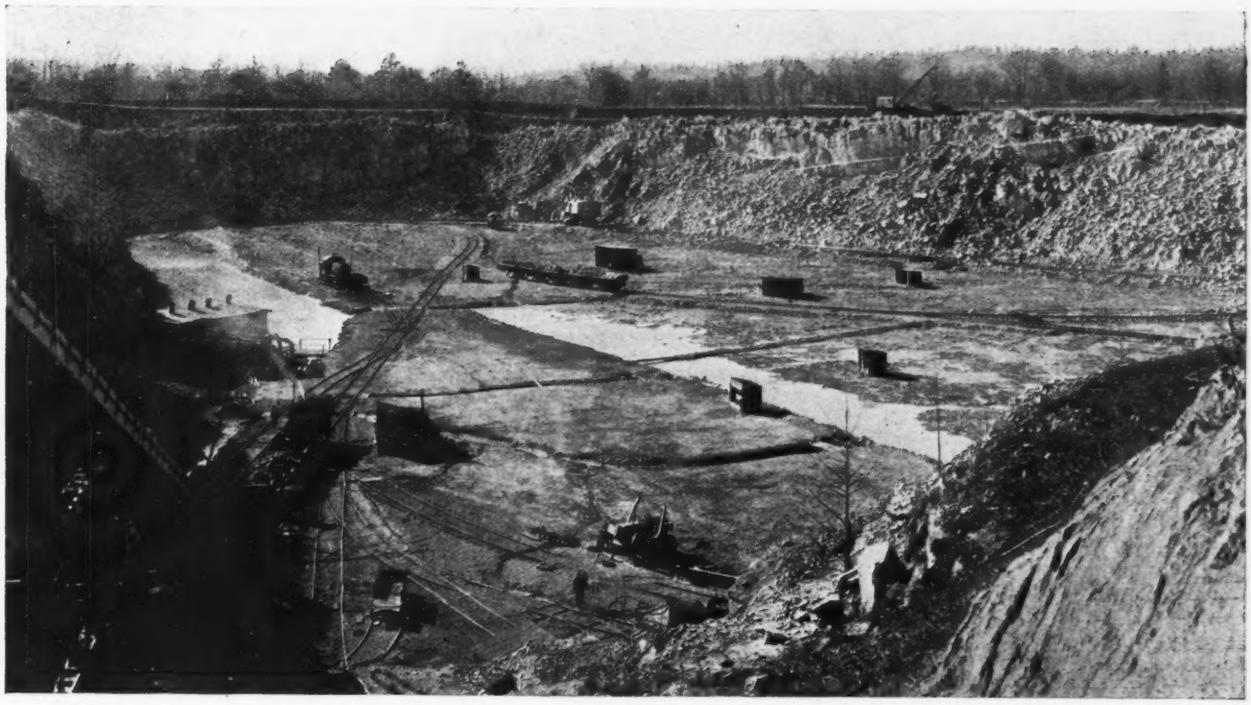
Thus far, notes to Mexico City regarding the seizure, not of the great petroleum properties, but of the relatively insignificant $10,000,000 worth of farm lands taken prior to 1927, have met with unsatisfactory replies. Mexico's evident inability to meet even such small obligations points the unwisdom of its colossal oil expropriation, this doubtless to be the subject of future notes. Reassuring to mine operators must be this evidence that Washington at long last is awake to the folly of letting "unadulterated confiscation" proceed in silence.

Evident also since the expropriation of last March is the fact that the press in the United States has at last been made aware that all is not right below the border. From almost complete silence for years regarding the plight of the American operator in the Republic, it has now passed to the stage where even relatively slight happenings are magnified, as recently when the acquisition by "co-operatives" of a few more marginal properties was made to appear like the mining industry's day of doom.

Labor Negotiations in Utah

DISAPPOINTMENT was caused in the ranks of both employees and executives of mining companies in the State of Utah last month when the labor contract agreed upon by the local unions and the operators was rejected suddenly by the executive board of the International Union of Mine, Mill and Smelter Workers, the latter alleging a gross misunderstanding as to its interpretation and that the seniority clause was in violation of the Wagner Act. The contract drawn recognized the Union as the sole collective bargaining agency, provided protection for reemployment after mass layoffs, raised minimum wages, and assured collective bargaining rights for the period of its life. Incidentally, it specified a sliding wage scale tied directly to the price of copper and to a lesser extent to the price of lead, "both as published in *Engineering and Mining Journal,*" a reassuring recognition by the local labor leaders that increased compensation must in general come out of production; that there is a direct relation between the amount that industry can pay out in wages and what it receives for its product.

The surprise occasioned by the act of the executive board remains to be dispelled. Whether it betokens some higher strategy beyond the ken of the local unions, or is evidence of dissension in labor circles, or is caused by some real defect in the agreement itself, one can only speculate. If the last be true, the defect should be corrected without delay. In any case, the procedure followed can be bettered. Rejection by the executive board of contracts approved by officials of both sides suggests a rather too close control of labor.



IN THE QUARRY, a general view. The incline leading to the working plant is in the lower left. Stripping is in progress with a dragline on the far side above the bench

Quarrying Dolomite

At Dolonah, Alabama

A water problem solved by diverting creek. Adjacent crushing, screening, and washing plant can prepare 125 tons of fluxing stone per hour for Ensley and Fairfield furnaces

E. M. Ball
General Superintendent

A. W. Beck
Chief Engineer

Tennessee Coal, Iron & Railroad Company
Subsidiary United States Steel Corporation
Birmingham, Alabama

AT DOLONAH, two miles west of Bessemer, Ala., the Tennessee Coal, Iron & Railroad Company operates a dolomite quarry which has presented unique problems in the control and handling of water and in mining a deposit in which numerous crevices and erosion cavities extend to the quarry floor. These are responsible for a large percentage of waste material.

The preparation plant is designed for the production of 125 tons per hour. It produces two sizes of metallurgical stone. The lump stone, 4½ to ¾ in. in size, is used in the company's blast furnaces at both Fairfield and Ensley, in Alabama. The screenings, ranging from ¾ to 0.120 in., are used for "making bottom" in the open-hearth furnaces. At Fairfield Steel Works both raw and burned screenings are used for this purpose, and at Ensley only burned screenings are used. All dolomite is shipped from the quarry to the furnaces over the company's own railroad system.

The average composition of the stone produced in 1937 is given in the accompanying table.

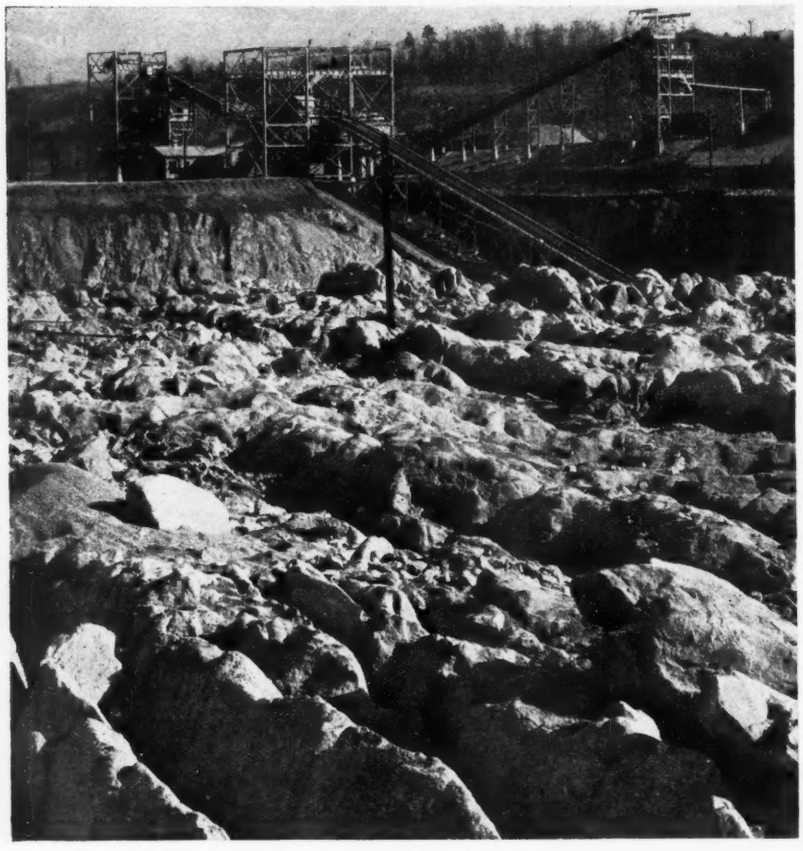
A cross-section through several of the diamond-drill holes in Fig. 1 shows the relation of the quarry to the formation worked. The fluxing stone of this area occurs in the Ketona dolomite, which is about 600 ft. thick and lies at the base of the Copper Ridge formation, just above the Conasauga Cambrian limestone. The workable stone in general consists of massive beds of medium- to coarse-grained light-gray dolomite. In this are found occasional beds of dark-gray finer-grained stone, which shows a higher silica content. At the top, the formation grades into thin-bedded fine-grained rock with gradually increasing amounts of chert. At the base, the dolomite grades gradually into the limestone, there being an alteration of the limestone to a high-lime dolomite close to the contact. The dip of the stone averages approximately 10 deg.

Prior to June, 1931, dolomite for the company was obtained from Ketona quarry, near Tarrant City, Ala., six miles north of Birmingham. This source of supply was abandoned because of high transportation cost and the depletion of the reserves of higher-grade stone.

In 1926, extensive diamond drilling was undertaken at Dolonah to determine the extent and quality of the dolomite. This drilling indicated the presence of a large deposit of high-

Average Composition of Dolomite Shipped for Year 1937

Type of Stone	Per Cent SiO_2	Per Cent Fe_2O_3 and Al_2O_3	Per Cent $CaCO_3$	Per Cent $MgCO_3$
Lump	1.08	0.68	55.65	41.96
Screenings	1.14	0.71	55.35	42.44



STRIPPED GROUND north of the quarry. This and the adjacent cut show the irregular surface of the dolomite. In the distance is the crushing, screening, and washing plant

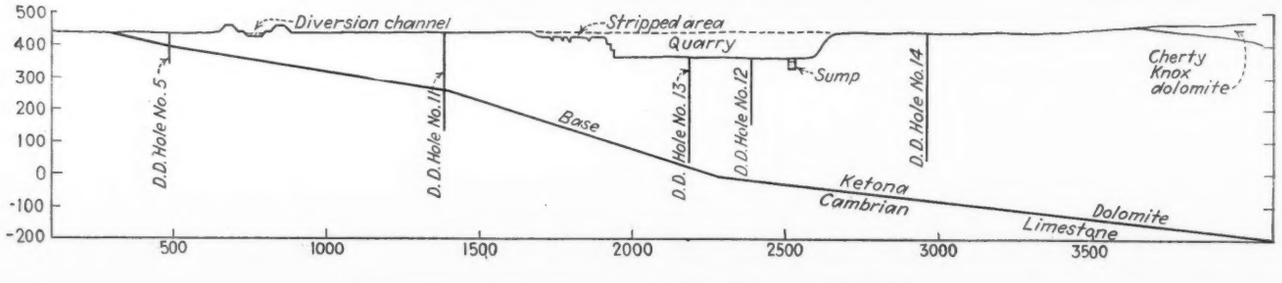
grade stone. With the aid of this, an area was selected as a site for opening the quarry. The northwestern limit of the area was 400 ft. from Valley Creek and the southeastern limit approximately 300 ft. from a branch of the Louisville & Nashville Railroad.

In developing the quarry, a temporary spur track was run from the L. & N. line to the quarry site for handling material and supplies while the extension of the Tennessee Coal, Iron & Railroad Company's transportation system to Dolonah was being made. The 10 to 12 ft. of clay and earth overlying the dolomite in an area of about three acres was removed with steam shovels. This material was used for making fills for the plant tracks and for a protection levee adjacent to Valley Creek.

The top of the stone was very irregular, being traversed by numerous ero-

STRIPPING of the dolomite bed under way. In addition to the work done by the dragline excavator, much hand cleaning is necessary, thanks to the irregular surface of the stone

Fig. 1 . . . THE RELATION of the Dolonah quarry workings to the geological formation that is being worked is shown by this cross-section.



THE QUARRY WALL, illustrating the benching method employed

sion crevices and cavities, necessitating a great amount of hand cleaning after the preliminary stripping was completed.

The sinking of a quarry incline on a 17-deg. slope was begun in the latter part of 1928. This cut, averaging 54 ft. in width, was sunk by hand to the 50-ft. level, where an electric power shovel was installed and the face extended approximately 400 ft. The quarry floor then was lowered to the present 70-ft. level by excavating with the power shovel. Water was encountered in sinking the incline. It gradually increased to 1,500 g.p.m. when the 70-ft. level was reached. However, by the time this level was advanced about 300 ft. from the foot of the incline, 2,700 g.p.m. was being pumped.

The original proposal as to the development of the property included the installation of a primary crusher below the level of the quarry floor, from which the stone crushed was to be removed by means of a belt conveyor and delivered to the secondary crushing, screening, and washing plant at the top of the incline. A shaft was sunk near the proposed location of the primary crusher. It was planned to connect the bottom of this shaft with the bottom of a crusher pit, by means of a tunnel, and to install deep-well pumps in the shaft. As the shaft was sunk, the flow of water increased to 5,500 g.p.m. at a depth of 60 ft.; also, it was found that the crevices and cavities extended to this depth.

An effort then was made to seal these crevices below the quarry floor before excavating the crusher pit and conveyor tunnel. Fourteen churn-drill holes were sunk around the perimeter of the shaft to an average depth of 70 ft. and spaced evenly at a distance of 6 ft. from the shaft. Ninety-eight tons of hot asphalt were pumped into these holes. Although the water coming into the shaft was materially reduced, it was evident that the driving of a connecting tunnel from the shaft and the excavation of the crusher pit would have again increased the flow of water. It was decided to change the location of the primary crusher from below the quarry floor, as originally planned, to a point on the surface at the head of the incline, the material to be handled from the quarry face in cars to the foot of the incline by locomotives and then hoisted up a steel trestle to the primary crusher. This arrangement proved successful when finally put in operation. But, as the quarry advanced toward Valley Creek, more serious trouble was encountered. This will be discussed later.

While the quarry was being developed, the secondary crusher was installed to handle stone mined in sinking the incline and extending the quarry face. This stone was hoisted up a temporary trestle to the secondary crusher, where it was prepared for furnace use. Simultaneously with this work, construction was in progress on the railroad extension, plant building, screenings, washer, tailings-disposal equipment, and power-transmission lines. In the early part of 1931, the primary crusher and steel trestle were erected, and the quarry was placed in operation in June, 1931. At present the quarry occupies an area of about twelve acres.

During the early period of operations, the stone was broken from the quarry wall by well-drill blasting. However, well-drill holes could not be blasted effectively, due to the numerous crevices and cavities in the stone. Considerable force of the blasts was lost by cushioning the explosion in the mud filling these crevices. All drilling at the present time is done with jackhammer drills. Benches are carried on the quarry wall more or less irregularly, averaging 15 to 20 ft. high and 10 to 15 ft. wide. Holes about 15 ft. deep are drilled from these benches, radiating from vertical holes to nearly horizontal toe holes.

Seven two-man drilling crews, working with 50 lb. 2½-in. jackhammer drills using ⅞-in. hollow hexagon steel, do the necessary drilling on a single shift to break the stone for a double-shift operation. Holes are blasted with a semi-gelatin dynamite with a weight strength of approximately 65 per cent, in 1¼x8-in. cartridges. Horizontal holes are tamped with clay-filled bags; vertical holes with sand-filled bags. Blasts are fired at the noon period and at the end of the day shift by electric detonators. Secondary blasting is done with fuse and caps. An average of 4.5 gross tons of stone is broken per pound of explosive.

The broken dolomite is loaded from the quarry face by a full revolving electric shovel mounted on crawlers and equipped with a 3-cu.yd. dipper.

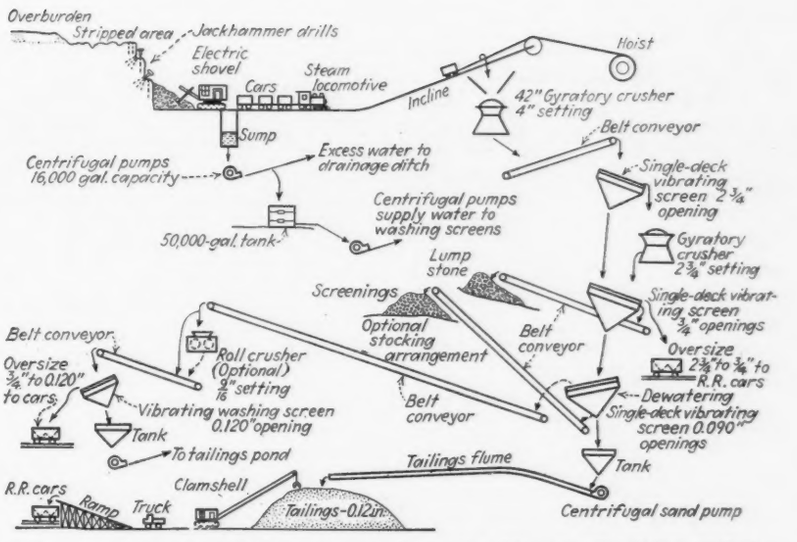


Fig. 2 . . . FROM QUARRY FACE to railroad cars for shipment, after being crushed, screened, and washed, dolomite is handled according to this flowsheet

CRUSHING, screening, and washing of the dolomite are done in this plant. The primary crushing section is in the center and the secondary at the right, with the stocking conveyors leading up to the left from under the track. In the left background is the screenings washer

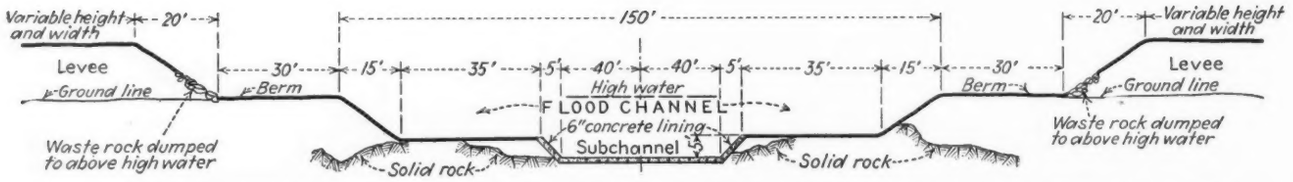


Fig. 3 . . . MAIN DIVERSION CHANNEL, here shown in cross-section, is approximately 6,000 ft. in length, the lower 4,000 ft. having a concrete-lined sub-channel to take the creek's normal flow

The shovel delivers the stone into 10-ton steel side-dump cars, which are hauled by a steam locomotive in trains of five to the foot of the hoisting incline. One car at a time is hoisted up the steel trestle by means of a 350-hp. electric hoist located at ground level some 100 ft. back of the upper end of the trestle. The hoist is operated by remote control from a station on the dumping platform. The cars are dumped into a hopper over a 42-in. gyratory crusher set to approximately 4 in.

Stone discharged from the crusher is conveyed by belt to a vibrating scalping screen having $2\frac{3}{4}$-in. square openings, as shown in the flowsheet in Fig. 2. The oversize is delivered to a No. 8 gyratory crusher set at $2\frac{3}{4}$ in. Discharge from the secondary crusher and undersize from the scalping screen are chuted to two single-deck sizing screens having $\frac{3}{4}$-in. square openings. All screens are equipped with high-pressure water sprays. Plus-$\frac{3}{4}$-in. stone is delivered direct to railroad cars for shipment to the blast furnaces. Minus $\frac{3}{4}$-in. dolomite passes over a single-deck dewatering screen with 0.090-in. openings. Undersize material, with the excess water, is piped to a sump tank, from which it is pumped, by means of a sand pump, to the tailings pile. Oversize stone is conveyed to a 42x16-in. roll crusher.

The third stage of crushing is optional. At present, the stone is being bypassed to a belt conveyor, which delivers the product to the screening washer equipped with a single-deck vibrating screen with 0.120-in. square openings. Oversize material is delivered to cars. Undersize goes to a sump tank and is pumped to the tailings pond. The secondary crushing and screening plant has an optional arrangement whereby both the furnace stone and screenings can be conveyed to a small hopper and then stocked.

The material pumped to the tailings pond represents about 15 per cent of the total stone removed from the quarry. Most of the fines are a dolomitic sand filling the crevices and cavities in the stone and have practically the same chemical analysis as the lump dolomite. Although these tailings have no metallurgical value at present, a market has been developed in the last few years for a large amount of this material to be used as a filler in commercial fertilizer.

The plant is built of steel throughout, with concrete foundations for all structures and equipment. An automatic sequence starting and stopping system is used for all plant motors, which are controlled from a main switchboard in the control room. Local pushbutton switches also are used.

Power for the operation of all electrical equipment is furnished from a central power house at Fairfield Steel Works. It is delivered at 44,000 volts to a 3,000-kva. transformer substation, located near the secondary crushing and screening plant, where the voltage is reduced to 2,300. Power from this station is distributed to the various units through armored cable. All motors of 25-hp. or larger are operated at 2,300 volts. Smaller motors use 220 volts. All motors use alternating current, with the exception of the electric shovel, which is operated with Ward Leonard control.

All water in the quarry is drained to the abandoned shaft, where four centrifugal pumps with a combined capacity of 16,000 g.p.m. are situated. A portion of the water from the quarry is pumped to storage in a 50,000-gal. steel tank from which it is picked up by the pressure pumps for the spray nozzles on the vibrating washing screens. The remainder of the water is pumped to waste.

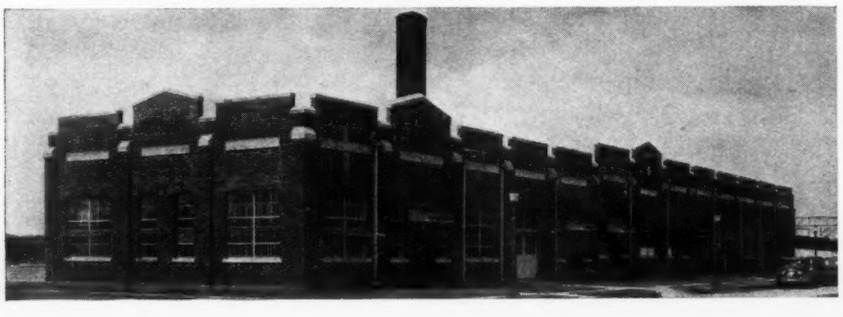
In 1932, the northwest wall of the quarry had advanced to within 200 ft. of Valley Creek, and the flow of water in the quarry was continually increasing. A number of sink holes, which had developed in the creek bed adjacent to the quarry, were filled with rock and concrete. Although the filling of these holes reduced the flow of water to some extent, there was a constant danger of flooding the quarry should blasts on the quarry wall open an erosion channel in the stone directly connected to the creek bed. After a careful survey of the water table determined from the diamond-drill holes, the use of coloring matter in the water, chemical analysis of the creek water and quarry water, and gaging the water in the creek at points above and below the quarry, it was concluded that the water table was being fed through a great number of sink holes in the bottom of the creek. As the water table was at a higher elevation than the quarry floor and the logical extension of the quarry was to be northwest, it was decided to excavate a new channel for Valley Creek some 1,500 ft. to the north. This work was started in the summer of 1932 and completed in the spring of 1933. The main diversion channel is approximately 6,000 ft. long, the lower 4,000 ft. having a concrete lined sub-channel to accommodate the normal flow of the creek. (See Fig. 3.) A smaller channel, likewise concrete-lined, was excavated to take the flow of Hall's branch. This smaller diversion channel connected with the larger. (See Fig. 4.)

Soon after the diversion of the creek, there was a marked reduction in the flow of water in the quarry. At present, during the dry summer months, practically all the water pumped from the quarry is used for washing the stone.

The plant building, situated near the southwest end of the quarry, houses the office, the supply house, a dispensary, shower and locker rooms, an electric repair shop, a blacksmith shop, and a 1,500-ft. compressor.

In all, 125 men are employed at Dolonah quarry for the double-shift

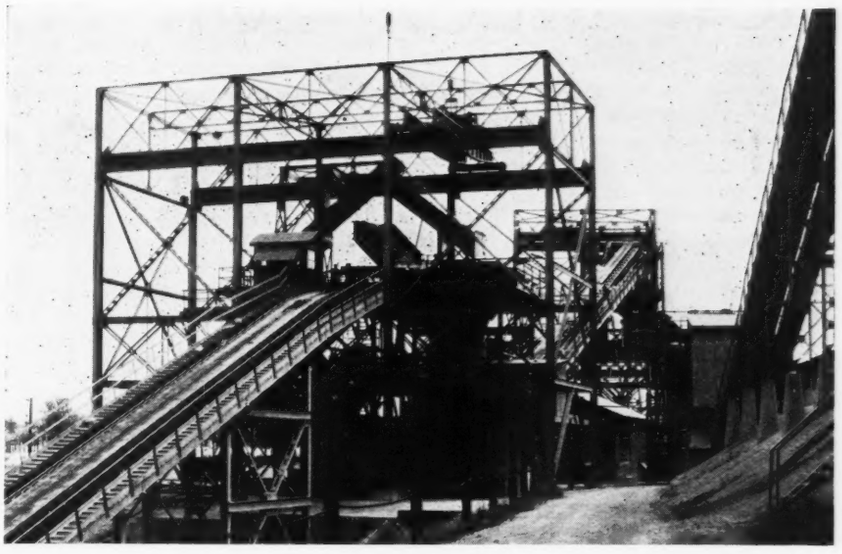
PLANT BUILDING at the quarry. This houses the offices (left), the supplies, compressors, showers, dispensary, and other departments



operation. In addition to the regular loading operation, all drilling and blasting is done on the day shift. Only loading is done during the afternoon shift. The crushing, screening, and washing operations extend throughout the two shifts. In 1937, approximately 500,000 gross tons of metallurgical stone was produced.

Every effort is made to prevent accidents. Safety guards and railings are provided throughout the plant. All men working on the quarry wall, cleaning off benches, and barring down loose material are protected by a rope anchored at the top of the wall and extending over the side. Safety shelters are provided in the quarry and on the surface where the men can be protected during blasting. All men are carefully instructed and trained in safety. The supervisory force constantly watches them to be sure that all precautions are taken. This safety campaign is reflected in the fact that there has been no disabling accident at Dolonah since January, 1937. During this time 301,894 man-hours have been worked.

The service of the local company physician or the use of the Employees' Hospital is optional with the employees. Those desiring this service pay a small monthly fee, which entitles them to dispensary service for themselves and their families and to hospitalization at the Employees' Hospital at a reduced rate. Employees living more than 2.5 miles from a company dispensary are required to pay for each visit of the doctor. Physicians are on call 24 hours each day. An ambulance is kept at the local dispensary for emergency use.

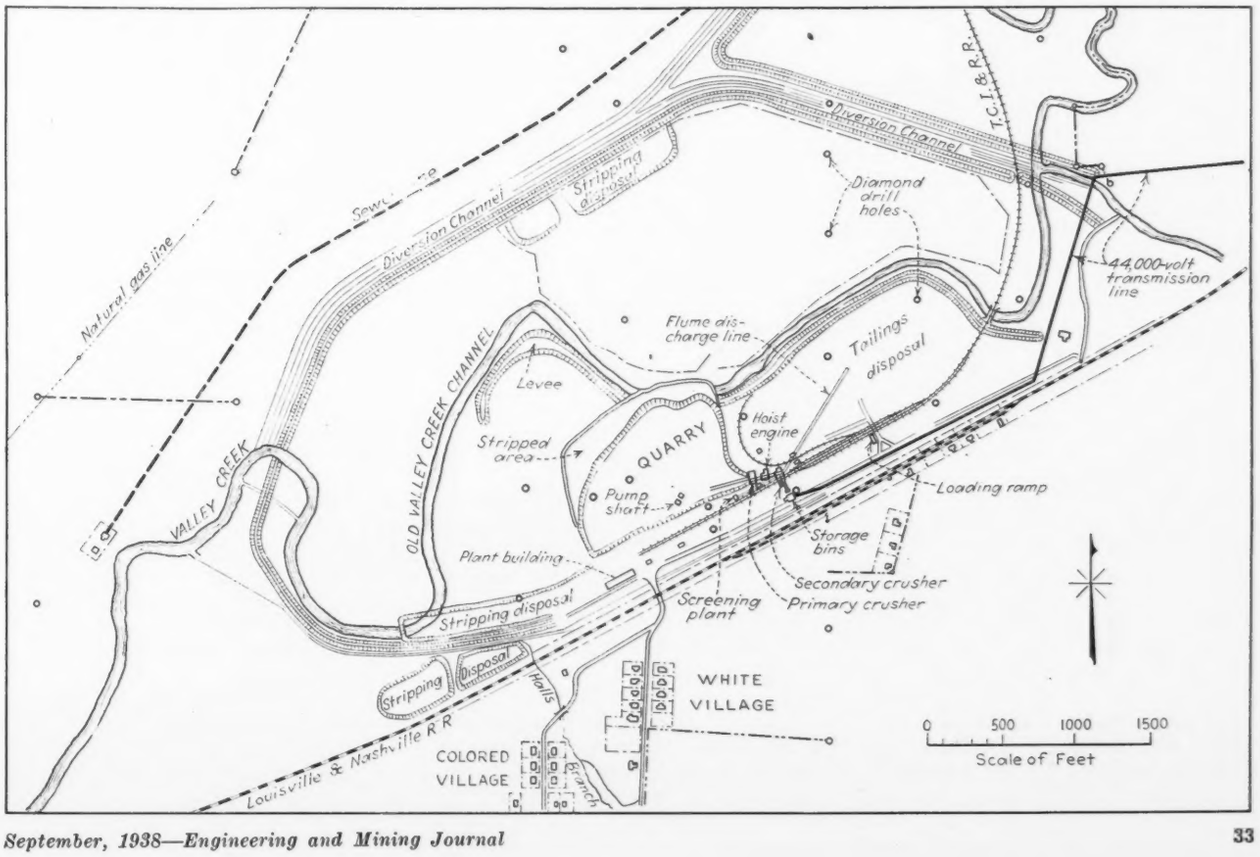


QUARRY CAR in dumping position at primary crusher. Remote-control station for hoist shown on dumping platform

In the event of an accident in or around the quarry, the injured person, after receiving first-aid by fellow workmen, is sent to the local dispensary, where he is given emergency treatment. If the accident is of a serious nature, the patient is immediately taken to the Employees' Hospital at Fairfield.

Most of the employees live in the company villages. The tidiness evident in these spots and around the plant is indicative of the interest displayed by the workmen in this operation.

Fig. 4 . . . MAP of Dolonah quarry showing the diversion channels. *A*, primary crusher. *B*, hoist engine. *C*, secondary crusher. *D*, loading ramp. *E*, storage bins. *F*, screening plant. *G*, pump shaft. *H*, flume discharge line. Small circles represent diamond-drill holes



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522 Fifth Avenue
New York

IN THIS LAST quarter-century of wide fluctuation in prices, the world has begun to realize that a coin is good, not for its name or its mint mark, but for what it will buy. In December, 1919, a dollar spent in this country for assorted wholesale commodities would buy only about one-third as much, and in April, 1926, only about half as much, as in May, 1895. When an article is sold for a dollar, therefore, it is exchanged for a varying and sometimes extremely variable buying power. Nor in general can its sales price be raised or lowered as the dollar buys less or more, in just the right proportion to maintain its value in terms of other goods (its *barter value*) unchanged.

The price of copper, for example, from May, 1895, to December, 1919, and April, 1926, did not vary as widely as wholesale prices in general, so that its barter value declined accordingly. In December, 1919, its barter value was about three-fifths, and in April, 1926, about two-thirds, of that value in May, 1895. Conversely, if in May, 1895, a standard lot of assorted wholesale commodities could be had in exchange for 1,000 lb. of copper, then the same lot in December, 1919, called for 1,683 lb. and in April, 1926, for 1,497 lb. of copper. It was such contrasts as these that prompted the accompanying graphs and their analysis.

The years 1896 and 1897 saw the end of a long decline in wholesale prices and the beginnings of a slow rise that was to continue, with minor interruptions, for 23 years. Thus 1897 became a pivotal year and has been selected as the starting point of the present analysis, which extends for 41 years to the end of 1937.

Since refined bar copper is itself a wholesale commodity, its barter value is naturally to be found in terms of goods of its own class. The markets for these are summarized in the monthly index of general wholesale prices published by the United States Bureau of Labor Statistics, the course of which is shown by the uppermost of the graphs accompanying this analysis. In any month, the index of a single commodity is the ratio of its price in that month to its average price in 1926, which the Bureau has adopted as a basic period. The index of "all" commodities, which is the subject of the graph, is a composite of these individual ratios. From time to time the number of individual items contributing to the composite has changed. Indices for some years prior to 1926 were based on 550, for 1926 and later years on 784 "price series."

To express in a single representative figure the almost infinite variety of prices and price movements during even a single month is an ideal that cannot altogether be expected to come true. Changes in human needs bring new commodities into use and do away with others or modify their importance, so that the index is founded on slowly shifting premises. It is a synthetic figure, built up of simpler indices of many individual commodities combined by a definite method, but one which nevertheless involves a certain human judgment in its selection. Other methods may (and do) yield slightly different indices. It is easy, therefore, to put too sharp a point on the meaning of the figures in their smaller details; but in general they represent a remarkable approach to the ideal, well able to sustain the broad conclusions drawn from a 41-year view.

Monthly copper prices in this analysis are the market quotations of the *Engineering and Mining Journal* for refined metal at New York, applied to Lake copper in 1897 and 1898 and to electrolytic thereafter. When the copper import duty became effective in the middle of 1932, *E.&M.J.* began publishing separate quotations for domestic and export delivery, and only the domestic are used here. As the wholesale price index also refers solely to domestic markets, the entire analysis is confined to price relations and barter values within the United States.

In order to place copper prices on the same basis with the wholesale price index, they have been expressed in the form of a copper-price index. That is, the market price of the metal each month has been divided by its average price in 1926, which was 13.795c. per pound; and the resulting monthly ratios are plotted in the second of the accompanying graphs. Because the 1926 divisor is a constant, the graph can also be read directly in cents per pound, for which a supplementary scale is provided.

These two indices, the index of copper prices and that of wholesale prices, are sufficient to determine month by month the barter value of copper: not its absolute barter value, which could be expressed only by a clumsy miscellany of many commodities in many different units, but its *relative* barter value, which is a simple ratio to some standard. For the barter value of copper obviously varies directly with its market price (that is, with the copper price index), and varies inversely as the composite market price of the goods for which it may be exchanged (that is, inversely as the wholesale price index). Therefore, if for each month the one index be divided by the other, the resulting quotients will vary among themselves in exact proportion to the fluctuation of barter value. And since the indices from which they were derived are both based on 1926 values as standard, these quotients are also ratios to a 1926 standard; and that standard obviously is the absolute barter value of copper in that year.

Thus these quotients constitute a monthly index of the barter value of copper, plotted in the third of the accompanying graphs. All three indices, together with those of the lowermost graph, still to be discussed, are ratios plotted to the same scale and graphically completely comparable.

At first glance the line of barter value may look much like the line of dollar value of the metal (copper price index), but a little study will reveal one striking difference. During most of the 41-year period, until the middle

of 1930, the line of dollar value takes the form of a fairly level baseline at about 13c., broken by several abrupt elevations. Barter value, on the other hand, which follows a generally similar course to the end of 1918, dropped sharply at that time to a new and markedly lower level, from which, except for a brief struggle in 1929, it has never since recovered. Thus the end of the War saw a fundamental change in the market relation of copper to wholesale commodities in general, and this change is the most striking fact brought out by the graphs.

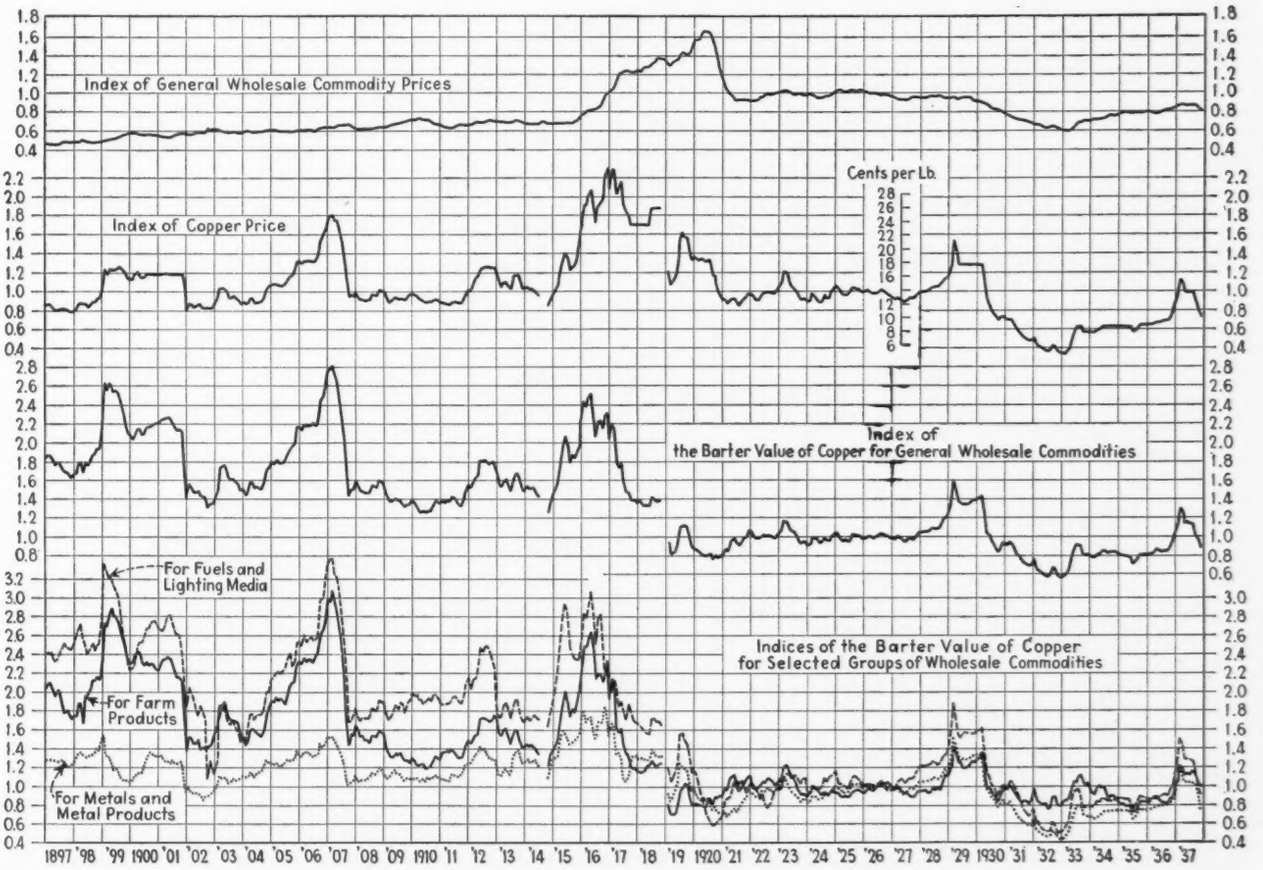
There was always the possibility that some large single group of wholesale commodities had dominated the wholesale price index, and that copper since 1918 had really changed its market relation, not to commodities in general, but merely to one such group in particular. As a test, the barter value of the metal was found for each of three well-defined and dissimilar groups, with results plotted in the lowermost (triple) graph. Of these groups, farm products represent an industry completely alien to copper production; fuels and lighting media represent an industry remotely allied; and metals and metal products represent the industry of which copper production is a part, although by no means a typical part, because the group also includes some complex machine products very different in marketing character from refined bar metal. With respect to farm products, and especially to fuels and lighting media, the sudden drop in barter value of copper at the end of 1918 is even more sharply marked than with wholesale commodities in general. With respect to metals and metal products, more closely akin to copper, the drop is much less striking, but nevertheless can be seen. It is clear, therefore, that the red metal has undergone a sharp decline in barter value, not for one group of commodities alone, but for goods of widely diverse character.

Some of the causes of this decline are well known. During the World War copper was a military necessity, and American production as a source of world supply was tremendously stimulated. With the armistice the war need collapsed, and both domestic and foreign deliveries fell sharply off, leaving the American producers for the time being with a very considerable excess capacity. Meanwhile, wholesale commodity prices were still rapidly rising, and there is no difficulty, therefore, in finding reasons for the precipitate drop in barter value of copper at the end of 1918, or for its depressed level in the months immediately following.

What happened later is perhaps more significant. For the next eleven years, or until the beginning of 1930, the *price* of copper resumed its pre-War course. Thus that section of the graph of copper price which lies between 1919 and 1930 closely resembles the section between 1897 and 1914, not only in general level but in characteristic outline. But wholesale commodity prices did not return to pre-War levels. True, after reaching their peak in 1920 they dropped sharply, but not as far as they had risen in 1916-1920. The facts may be interpreted according to one's temperament: either copper took a step in the right direction and got rid of wartime price inflation much earlier than other staples, or had the great misfortune to fall behind during the post-War boom. In either case its barter value suffered.

By 1930 the depression was at work.

A MONTHLY INDEX of the barter value of domestic copper—that is, of its value in terms of exchange for wholesale commodities, 1897-1937 inclusive—is given in the third graph from the top, which is derived from the two above it. The bottom group of curves supply supporting data


Index of General Wholesale Commodity Prices
Index of Copper Price
Cents per Lb.
Index of
the Barter Value of Copper for General Wholesale Commodities
For Fuels and
Lighting Media
For Farm
Products
For Metals and
Metal Products
Indices of the Barter Value of Copper
for Selected Groups of Wholesale Commodities
1897 '98 '99 1900 '01 '02 '03 '04 '05 '06 '07 '08 '09 1910 '11 '12 '13 '14 '15 '16 '17 '18 '19 1920 '21 '22 '23 '24 '25 '26 '27 '28 '29 1930 '31 '32 '33 '34 '35 '36 '37

Indices of Wholesale Commodity Prices are those of the U. S. Bureau of Labor Statistics. Copper Prices as quoted by the *Eng. & Min. Journ.* for refined metal at New York (Lake copper prior to 1899, electrolytic thereafter). During the period of the copper import duty (June 1932 onward), the quotations are those for domestic delivery only. Every index is calculated to average value in 1926 as base

At this time, after a long period of preparation, a new alignment of world copper supply had established itself, through the remarkable development of foreign sources during and after the War. So complete was this realignment that the United States not only lost its former position as a prime source of world supply, but for three years became a net importer of the metal. There is a certain momentum in the flow of new copper which makes it difficult to check, and during this period of readjustment and decline the American industry piled up enormous stocks. In 1932 and 1933, therefore, while wholesale commodity prices in spite of depression were scarcely declining below their pre-War level, the price of copper was sinking to a record low, so that its barter value again declined and reached the lowest level of the 41 years.

From this low level there has been some recent recovery, though not enough to put copper back in its old pre-War market relation to other goods. Nor does the 41-year record suggest any such recovery as a permanent hope. Even for the pre-War and war-time period of 1897-1918, the calculated trend of barter value was slightly downward, and if it had persisted would have brought copper to a new and lower price relation, even with no post-War boom in wholesale commodity prices and no rapid realignment of world supply. Thus the slow forces of supply and demand, of natural adjustment between one commodity and another, had been quietly at work for at least two decades before they received the sudden impetus of War and post-War conditions.

Yet for a staple so sure of its place in modern life, this gradual downward trend was not unhealthy. It merely posed a new set of conditions, and posed them slowly enough to give time for compensating adjustments within the industry and compensating refinements of process and costs. There is nothing in barter value itself that directly fixes costs of production or directly determines profit. If copper can be produced with no greater expenditure of human effort than is needed to produce the goods for which it is traded, whatever their amount may be, then the copper is worth producing and the trade is worth making. And the history of the 1897-1918 period shows that in the face of a gradual decline in barter value, copper continued to be well worth producing and trading for other goods.

However, with the violent dislocation of 1918-19 and the summary depression of barter value during the next few years, there were times when a considerable part of domestic supply was not worth taking out of the ground. The change had been too sudden and the time too short for compensating adjustment. Yet whenever barter value remained fairly stable for a while, as in the six years 1922-27, and again in the four years 1932-36, domestic output soon increased. That is, given a little time, production could adjust itself to a lower barter value and still make copper worth producing and trading for other goods.

Two decades have passed since the disruption of 1918-19, and a decade or more since the new foreign sources became, or promised to become, so large a factor in world supply. If barter value follows its general 1919-1937 course a few years longer, it will stand about where it would have stood had the gradual decline of 1897-1918 persisted. Meanwhile, a good deal of the compensating adjustment has been made, though made in the turmoil of disruption instead of in the comparatively easy circumstances of a slow decline. And with this history of the last two decades to supplement the lesson of the 1897-1918 period, there is nothing in the record to deny, and there is a great deal to show, that American production will complete its adjustment to the new level of barter value and go on about its business.

▼ ▼ ▼

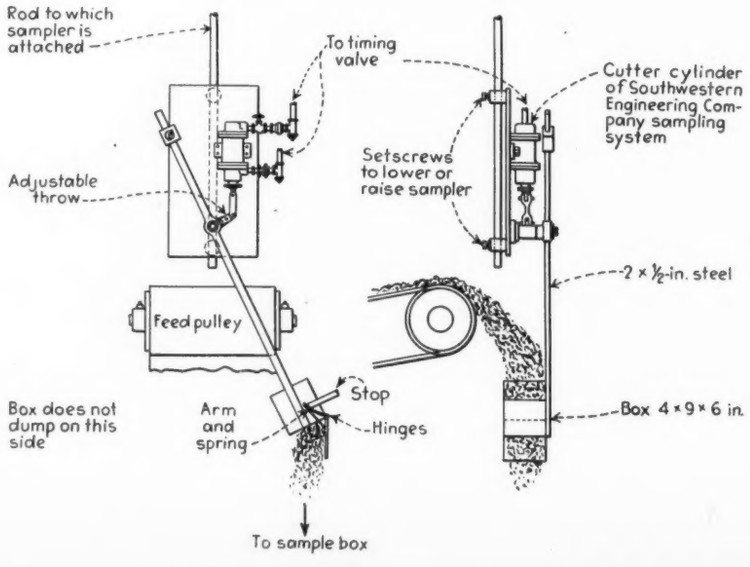
An Automatic Ore Sampler

SIMPLICITY of construction, dependable performance, and an initial cost that makes it possible for the small mine operator to install one are the outstanding features of the automatic sampler developed by R. W. Kelsey at the property of California Standard Gold Mines Corporation, Stent, Calif., for sampling mill heads. As detailed in the accompanying sketch, the device consists of two principal parts—namely, the sample cutter proper and the operating mechanism. Both are mounted on a rectangular steel plate attached to a steel rod, and adjustment up or down is by means of two setscrews. Horizontal clearance must be 6 in. or more.

The arm, containing at the lower end a 4x9x6-in. sample box of ¼-in. steel plate and a counterweight at the upper end, is made from 2x½-in. steel, and the mechanism operating it is an automatic sampler system manufactured by the Southwestern Engineering Company, of Los Angeles.

Briefly, this device consists of a pressure pump with storage tank, timing valve, and a suitable piping system between the cylinder on the steel plate and the timing valve. The actuating medium is oil, and the timing valve can be set to operate at intervals ranging from 5 to 30 min. Opening and closing of the hinged bottom of the box or cutter at the lower end of the steel arm is also automatic. The bottom is opened when the arm on the cutter presses against the stationary stop, and a spring snaps it shut when the cutter moves away from the stop. Material discharged by the cutter is collected in a sample box on the floor below.

The sampler worked satisfactorily on dry and large ore, wet fines, and clay ore, and no repairs of any kind were made during the six months' period it was in operation at the mill.


Rod to which sampler is attached
To timing valve
Cutter cylinder of Southwestern Engineering Company sampling system
Setscrews to lower or raise sampler
Adjustable throw
2 × ½-in. steel
Feed pulley
Stop
Box does not dump on this side
Arm and spring
Hinges
Box 4 × 9 × 6 in.
To sample box

Electrostatic Separation

Its Development as Revealed in Forty Years of Patent History

Herbert Banks Johnson

Vice-President, Ritter Products Corporation, Rochester, N. Y.

► IN THIS, THE FIRST *of a series of articles, Mr. Johnson presents a great deal of information, hitherto largely unpublished save in Patent Office documents, bearing on the development of the art of electrostatic separation, primarily as a means of separating economically valuable minerals from one another or from the accompanying gangue. This takes the form of abstracts of some 45 patents issued between 1870 and 1910 inclusive, and will serve to form a background for the subsequent articles, that will deal with the more recent developments and their possibilities, as well as with the fundamentals of the art.*

MANY ENGINEERS have had at least one experience with static electricity when they rubbed their feet on the parlor carpet to accumulate a static charge and then touched some member of the family. They likewise doubtless remember the pith-ball laboratory experiments in physics and the general rule that "like charges repel and unlike charges attract"; also that if they rub a piece of sealing wax, resin, or a glass rod on a piece of flannel, woolen, or silk, it becomes charged with static electricity and has the power of attracting or picking up light-weight bodies such as chaff, dust, pieces of tin foil, and paper.

To consider these simple experiments further, it is possible, in many cases, by rubbing an ordinary rubber pocket comb on one's coat sleeve quickly, to make a fairly good separation of materials, such as of chaff from ground coffee, straws from seeds and spices, finely ground mica, or graphite from quartz. This can be done by spreading the material to be separated on a cloth or any non-conductive or grounded surface; rubbing the comb until a static charge is accumulated, and then passing it over the material closely enough to attract the lighter, most conductive particles; discharging the comb by wiping these off and again recharging it and repeating the operation. In this way a fairly clean separation of the light-weight, conductive particles from the heavier less-conductive particles is accomplished. It will be noticed, however, that the static charge accumulated on the comb is not constant or controllable and is directly affected by weather or humidity conditions. It works much better in dry than in wet weather or high humidity.

Static electricity, when uncontrolled, is considerable of a nuisance, particularly in radio receiving sets during electrical storms. It also interferes with screening operations of many products, especially fine powders which accumulate a static charge through friction developed when the particles rub together.

Probably many do not realize that this action was discovered as early as 600 B.C., when it was thought to be the property of amber only, and that as early as 1600 A.D. Dr. Gilbert, of Colchester, England, found that a large number of other substances had the power of accumulating a static charge. His experiments led probably to the first use of the electroscope, which later was followed by Bennett's invention of the gold-leaf electroscope, modifications of which are used today.

Considerable activity is recorded of such scientists as Faraday, Franklin, Newton, Holtz, Kelvin, Armstrong, Wimshurst, and others who contributed to a general understanding of conductors and non-conductors; the behavior of materials under the influence of a static charge; the development of influence or inductive static current machines and Leyden jars for the collection of a considerable quantity of static charge.

The influence machine dates from 1860. It is recorded that Holtz' machine, invented in 1865, operated at 120 r.p.m., generating an electromotive force equal to 53,000 volts. This type of machine consisted of a pair of glass disks mounted on a spindle and rotated in opposite directions at a comparatively high rate of speed. The disks were placed so the inner surfaces were close together, allowing freedom of rotation. On the outer surface were cemented a number of sector-shaped strips, of thin brass or tin foil, spaced at equal distances apart. Each disk had the same number of sectors, so that at any given instant those on one disk would be opposite those on the other disk. Facing the outer surface of each disk was a metal rod with light tinsel brushes at the end, adjusted so they touched the metal sectors as the plates passed them during the rotation. These neutralizing rods made metallic connection between the diametically opposite sectors on the outside of the disk.

When the plates were rotated, an inductive action took place between the sectors of each disk and the charge of static electricity existing upon any sector of one disk exerted an influence on the adjoining sector of the other disk. If the sectors of one plate were charged positively and negatively respectively, they acted inductively upon the adjoining similar pair of sectors on the other disk and the brushes made metallic connection between the sectors, allowing the induced electric charges to distribute themselves. As the plates continued to rotate, a cumulative charge was built up, the sectors of each disk acting alternately as inductors until the accumulated charge was taken away by collecting combs.

A brief history covering the development of static separation, electrostatic separation, and the new principle of selective electrostatic separation should be of interest to engineers and others concerned with separating problems. My experience and close association with the development of the art during the past 30 years leads me to consider the subject under these three heads, relating to three corresponding consecutive periods.

The early static separation work, extending to about 1900, involved the use of friction and induction sources of static current supply.

The second period, that of electrostatic separation, extending from 1900

to 1930, saw the development and application of motors, generators, transformers, mechanical and tube rectifiers through the Cottrell process for precipitation of dust and fumes, and the Huff process for the separation of ores and other materials. Both processes were commercially successful and of great benefit to mankind.

Into the third period, from 1930 to date, falls the development of the Johnson process of selective electrostatic separation, with the new possibilities it presents of future applications of the general art, taking advantage of the reversibility behavior of minerals in a selective and closely controlled electrostatic field.

Static Separation

Static separation involved the use of friction and induction sources of static current supply as shown by the following list of early patents:

1870—Electrical Cotton-Picking Machine. Belt frictional static current supply. Static charge picks up the cotton after being shaken from plant bolls.

1880—Middlings Purifier. Rubber rolls rubbing against wool or silk brushes generating frictional static charge. Static charge removes impurities from grains and flour.

1881—Separating and Collecting Minerals by Electricity. Glass disk revolving between friction pads developing frictional static charge; separating metals from earthy matter by wetting and passing over an amalgamated surface coated with mercury and connected to source of frictional electricity, attracting or repelling the metals.

1881—Middlings Purifier. Rubber rolls rubbing against wool or silk pads, generating frictional static charge. Removing impurities from grains and flour by screening or sizing during separation.

1882—Middlings Purifier. Agitating the material under rubber plates rubbing against pads or brushes of wool, catskin, or other material to electrify surface of the plates and attract lighter particles from grains, flour, etc.

1882—Middlings Purifier. Frictionally charged plates close to belt conveyor attract the lighter particles and separate them from grain, flour, etc.

1883—Electrical Apparatus for and Method of Controlling Paper, Etc. Uses frictional static machine, influence machine, induction coil, magneto-electric generator, or battery of high potential. Static electricity used as a means of controlling paper and other materials, in holding, feeding, and delivering paper to various machines such as printing and embossing presses, bronzing machines, etc.

1883—Middlings Purifier. Frictional static charge used to charge horizontal disk revolving over grounded shaking-screen surface for removal of lighter particles from grains, flour, etc.

1884—Apparatus for Collecting and Removing Waste From Spinning Machines. Electricity generated by the running of a belt or by use of a driving pulley constructed as a dynamo-generator.

1886—Process of Depositing Solid Particles Suspended in Air or Gas. Static electricity developed by induction or friction. Condensing fumes in receptacle or chamber and separating fine particles which adhere to and are collected on grounded flue walls by means of a discharge of high-potential electricity from metal points or edges. *(This is one of the earliest United States patents pertaining to the art of dust precipitation, electrostatically.)*

1886—Machine for Concentrating Ores. Static frictional belt over screen supporting ore bed which is agitated by blast of air. Heavier particles pass through succeeding compartments and lighter particles are removed by static charge.

1891—Mechanism for Separating Sheets of Material. Frictional static electricity used for picking up single sheets of thin and light material, such as paper, light fabrics, tin foil, etc., used in printing presses, envelope making, gumming, and other similar machines.

1892—Method of and Apparatus for Separating Ores. Using static machine, such as Holtz' machine, or induction coil connected to electrified plate at discharge end of conveying belt which is vibrated to prevent particles sticking. Electrostatically separating gold from quartz through wide difference in specific gravity. *(It is interesting to know that this patent was issued to Thomas A. Edison, June 14, 1892, and that it made no reference to difference in electrical conductivity of gold and quartz. Claims are directed to the separation through the wide difference in specific gravity, which, to some extent, is true of course. The difference in electrostatic conductivity, however, was not referred to as a basic principle of the operation.)*

1895—Apparatus for Transforming Alternating Current Into Unidirectional Current. Apparatus by which electric currents from alternating current machines can be utilized to operate electrical devices which require straight or unidirectional current. *(Similar patents granted in France, Great Britain, Austria-Hungary, Switzerland.)*

1899—Apparatus for Separating Dust from Blast-Furnace Gases. Static current furnished from an electric machine or from a dynamo and high-tension transformer, discharged from barbs or points. Particles in suspended gases become separated or deposited.

1900—Grain Cleaner. One of the earliest patents describing separation of particles passing over an inclined plate whereon a static charge is generated by the movement and rubbing of the grain particles and separation made with the aid of a suction fan.

It is interesting to note from the early patent descriptions the diversified activities of these pioneer inventors, attempting improvements in the agricultural, flour, textile, printing, paper, electrical, and mining and metallurgical industries.

In general, the patentees were American, English, and German inventors, all active probably without personal contact or cooperative effort through correspondence or publications. All the inventors depended entirely upon various means of developing friction and induction static current for the successful operation of their separating equipment. Some of their mechanical designs for feeding, conveying, and handling the materials were ingenious and workable. With our long experience and looking back on the difficulties of static separation with any type of friction or induction static generators, what disappointments they must have experienced in trying to operate commercially with such an unreliable current supply, operating with some degree of success in fair dry weather and complete failure in wet weather or in periods of high humidity.

The capacity of any friction or induction static-generating device is so small that any source of electrical loss or discharge seriously affects the separating efficiency. Although workable to some extent under certain conditions and on small-capacity demonstrations, this source of current supply is not recommended for commercial applications. This was well brought out by the early experience of Blake-Morscher in trying to apply their separating equipment commercially for the separation of zinc-iron table middlings.

Electrostatic Separation

The second phase of the development is of real importance, as will be shown by a study of the patents issued by the United States Patent Office between 1900 and 1910. It was a period of important activity which began to develop ideas that were the starting point and foundation of successful commercial applications.

The inventors of this period had learned of the failure of friction and induction static current sources of supply and were beginning to think along the lines of motors, generators, transformers, and rectifiers in an attempt to get a reliable source of current which would operate under all conditions and with large enough capacities to supply not only one but several separating machines.

Patent specifications are rather dry and complicated reading matter, but are important in considering the history of electrostatic separation. I have attempted, in the following abstract, to condense each subject simply, to convey the general idea and contribution to the art by the inventors, so as to bring out the prominent features which contributed so largely to the successful applications.

The following list of United States patents will indicate the trend of thinking and research in developing a more stable means of electrostatic

CHARLES H. HUFF
The "grandfather" of electrostatic separation

separation, which, of course, always has been one of the basic principles of ore dressing, involving the difference in electrostatic surface conductivity of the materials to be separated.

1900—Electrostatic Separation. Issued to Elmer Gates, Chevy Chase, Md. Refers to separation of anelectric materials (materials that are incapable of being electrified by friction) from idiolectric materials (capable of becoming electrified by friction). Describes a stream of mixed materials falling some distance and passing between a positive and a negative electrode. Uses Leyden jars in tension in connection with an 18-in. ten-plate static machine to get the equivalent of a 3-ft spark which will repel the metal particles further than the sand particles.

1901—Process of Electrical Separation of Conductors From Non-Conductors. Issued to Lucien I. Blake, of Lawrence, and Lawrence N. Morscher, of Neodesha, Kan. When a mixture of conducting and non-conducting particles is subjected to an electrostatic field, conductors acquire their inductive or direct charge instantly, whereas the non-conductors require more time to become charged. The greater the difference in potential between the mixed particles and the conducting surface, the more marked will be the repelling action. Passes a stream of mixed particles through an electrostatic field of one potential and then through an electrostatic field of another potential. Belt conveyor, feed type, repelling conductors from a grounded plate to an oppositely charged electrode.

1901—Mechanism for Separation of Conductors from Non-conductors. Issued to Lucien I. Blake and Lawrence N. Morscher, of Kansas. Precharges mixed materials with a negative charge before delivery to a revolving roll positively charged. Repels the better conductors from the revolving positively charged roll, the non-conductors adhering to the periphery of the positively charged wheel and carried around, either falling off when the lower part of the revolving roll is reached or being scraped off by any suitable scraper.

1901—Electric Ore Concentrator. Issued to H. M. Steele and W. L. Steele, of Dallas, Tex. Uses an electrically repulsive screen placed adjacent to an electrified belt conveying the ground ore and uses an air suction device for removal of the non-conductive particles by lifting them off the electrified belt.

1901—Process of Concentration. Issued to Henry M. Sutton and Walter L. Steele, of Dallas, Tex. Electrically charging a ground mixture on belt and exposing to screening member located above belt and capable of electrical repulsive action upon the conductive or metallic substance. Removing non-conductive or non-metallic particles from belt and electrically repulsive screen by air suction or other extraneous force.

1901—Method of Separating Valuable Metals From Metal-bearing Material. Issued to Clinton E. Dolbear, of Hyde Park, Mass. Assigned to American Mining & Metal Extraction Company. Separating conductors from non-conductors by subjecting to influence of electrode highly charged with electricity, repelling conductors while non-conductors remain under attracting influence of electrode and are separately collected. Subjecting conductors and non-conductors to action of oppositely charged electrodes, interposing between electrodes a non-conducting partition for delivering separated products to suitable receptacles.

1902—Apparatus for Separating Conductors From Non-conductors. Issued to Walter G. Swart, Denver, Colo., and Lucien I. Blake, Lawrence, Kan. Feed board device for belt-type separator to improve distribution of material in electrostatic field.

1902—Process of Magnetically and Statically Treating Ores. Issued to Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Tex. A combination magnetic-electrostatic separator, belt-conveyor type, lifting by suction the non-metallic, magnetic particles from a charged belt. *(This is probably one of the first attempts to combine magnetic and static principles of separation in one machine.)*

1902—Ore Conveying Surface for Electrical Separators. Issued to Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Tex. Coating belt conveyors, chutes, and drums with a conducting surface upon an insulating material to permit the accumulation of a large electrical charge on the conductive surface.

1903—Electrostatic Separator. Issued to Clinton Emerson Dolbear, Boston, Mass., assigned to American Mining & Metal Extraction Company, Boston, Mass. Feeding material in chutes by gravity fall so that the material passes between a positively and negatively charged electrode, separating conductive from non-conductive particles.

1903—Means for Electric Separation. Issued to Elmer Gates, Chevy Chase, Md. Ground material fed by gravity into vertical cylinder having charged semisphere in center attracting the conductive particles which are removed by suction.

1904—Electric Separator. Issued to Alonzo H. Perry, St. Louis County, Mo. Using an inclined feed plate composed partly of conductive and non-conductive material, the conductive part being within the inductive influence of charged receiving plate and means for preventing the contact of metallic particles with charged receiving plate.

1905—Electrostatic Magnetic Separator. Issued to Henry M. Sutton, Wal-

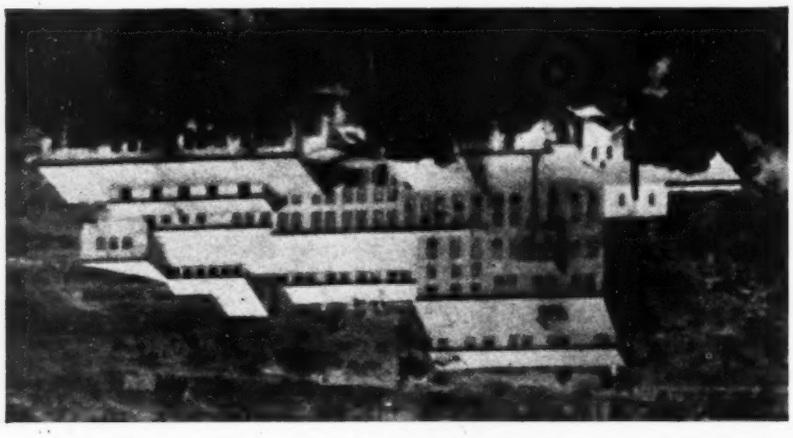
ter L. Steele, and Edwin G. Steele, Dallas, Tex. A magnetic separator assisted by the presence of static electricity for the recovery of fine gold. Subjecting the ore first to magnetic separation and further separating the tailings electrostatically by lifting the non-conductive particles from a belt conveyor and removing by suction.

1905—Apparatus for Electrostatic Separation. Issued to Greenleaf Whittier Pickard, Amesbury, Mass. Assigned to Charles H. Huff, Brockton, Mass. Regulation both as to potential and duration of charge of electrical energy applied to pair of electrodes so that charge may be adapted to a diversity of materials and conditions of electrostatic separation.

Refers to separating apparatus in the Dolbear patent issued in 1901 and to use of high-frequency alternating-current dynamo with suitable transformer to bring maximum potential of static field up to effective pressure. Teaches selection of normal characteristic phase curve and means of excluding from separating electrode all potential created except selected portion represented by area included between intermediate ordinates of phase curve.

Describes apparatus for exciting static electrodes, source of alternating potential. Electrodes normally insulated from source by spark gap which connects the electrodes momentarily with a condenser through a shunt to deplete the electrode potential after its establishment by the spark gap and means for rectifying one of the alternate phases of potential.

(This contribution of Pickard was probably the beginning of commercial electrostatic separation, offering a more reliable and continuous control of actual separating media, electrostatic current.)



THIS PLANT was designed and built by the author at Burnett, Tex., for separating and refining graphite. It was operated continuously from 1916 to 1926, when it was burned. From 1920 until its destruction, it ran 24 hours per day, producing about 2,000 lb. of flake graphite per hour by electrostatic separation

1905—Method of Electrostatic Separation. Issued to Greenleaf W. Pickard, Boston, Mass. Assigned to Charles Henry Huff, Brockton, Mass. Electrical apparatus for producing sharp potential variations, thereby regulating and reducing the time element in the potential phase cycle as it is effectuated at the separating electrodes while retaining all the values of high potential for separating purposes.

Cutting out more or less of the potential ordinates at will, leaving only such portions of the crest of the cycle wave as may be found desirable for separating purposes to be communicated to the separating electrodes. Providing electrode impulses or excitations which may be reduced to infinitesimal time intervals. If potential is supplied by alternating-current dynamo having a frequency of 50 per second, the separating electrode excitation can be reduced to two or three millionths of a second.

(Another very important development in electrostatic current regulation and control.)

1905—Apparatus for Electrostatic Separation of Substances of Diverse Electric Susceptibilities. Issued to Charles H. Huff, Brockton, Mass. An improvement of the Dolbear patent issued in 1901. Introduction of an adjustable divider between the separating electrodes so that advantage can be taken of both the difference in repelling force of the particles and the difference in time required by the particles to become charged.

Used a stationary horizontal charged repelling electrode with a dielectric envelope in combination with a horizontal rotating metallic electrode conveying the material into the electrostatic field and an adjustable horizontal dielectric divider for continuously dividing the separated products.

Used a horizontal charged electrode consisting of a small-diameter wire enveloped in a glass tube so small in diameter in relation to the oppositely charged metallic material conveying electrode as to greatly intensify and concentrate the lines of force in the electrostatic separating field.

(This patent was also of great importance in contributing to the successful commercial application of electrostatic separation.)

1905—Method of Electrostatic Separation. Issued to Phillip Henry Wynne, Boston, Mass. Assigned to Charles Henry Huff, Brockton, Mass. Electrical apparatus consisting of high-frequency alternating-current dynamo, rectifier furnishing electrostatic current supply. Used rapid, varied and briefly applied potential and controlled to be always positive or negative by use of a rectifier in the transformer circuit.

Noted difference in apparent conductivity of particles in relation to their moisture or hygroscopic qualities. Discovered that with certain adjustments of the mechanical and electrical conditions, especially frequency brevity and abruptness of potential variations, an electrostatic separation could be made of particles of light specific gravity from heavy particles and that, by further submitting the material to another pair of electrodes with different adjustments, a further separation could be made by electrostatic repulsion, regardless of specific gravity.

1906—Process of Separating Substances of Different Dielectric Capacities. Issued to Henry W. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Tex. Using static current to produce dielectric hysteresis in the substance to be separated. No dependence is required upon specific gravity, electrical conductivity, or non-conductivity of the particles, all of which in actual practice are so slight as to render practical separation difficult. Subjecting material to action of electrostatic charges varying in duration and potential of their opposite signs to establish dielectric hysteretic impedance and collecting the separated components. Passing material through a field having at one point an alternating static charge and at the opposite point a constant static charge to establish dielectric hysteretic impedance.

(This is one of the first references to separation through dielectric hysteretic impedance instead of the difference in electrical conductivity of the particles.)

1906—Electrostatic Apparatus. Issued to Lucien I. Blake, Lawrence, Kan. Electrical apparatus consisting of induction coil producing alternating high-potential impulses in its secondary coil winding and a conveyor comprising a casing, a covered electrode and an exposed point electrode within said casing with an adjusting screw having varying potential and means to allow the convective discharge of electricity to produce unidirectional discharges of substantially uniform tension.

1906—Ore Separator. Issued to Edwin A. Sperry, Denver, Colo. Ore fed between horizontal circular disks and discharged at the outer peripheral opening between, then into an electrostatic field between these feeding disks and a ring or annular member of soft iron located adjacent to the discharge slit in the periphery of such centrifugal distributor.

1906—Method of Electrostatic Separation. Issued to Greenleaf Whittier Pickard, Amesbury, Mass. Assigned to Huff Electrostatic Separator Company. A corporation of Maine. Heating the mixture to be separated and thereafter subjecting it to electrostatic separative influence in a heated atmosphere. Using a series of grounded heated revolving cylinders as material conveying electrodes.

1906—Apparatus for Electrostatic Separation. Issued to Greenleaf Whittier Pickard, Amesbury, Mass. Assigned to Huff Electrostatic Separator Company. Means of heating cylindrical electrodes by passing hot gases into interior of said

cylinders, thereby controlling the atmosphere around the electrodes and improving the separation of materials.

1906—Elecrostatic Separator. Issued to Millard Woodsome, Boston, Mass. Assigned to Huff Electrostatic Separator Company. Combination of metallic casings inclosing a series of cylindrical electrodes of large diameter having opposite the material conveying electrodes several small-diameter charged electrodes.

(This is probably the first all-metal electrostatic separator.)

1906—Electrostatic Apparatus. Issued to Millard Woodsome, Boston, Mass. Assigned to Huff Electrostatic Separator Company. An electrostatic classifying separator for removing the slimes (fine dust) from ores and other materials. Using, probably for the first time, a double separator, two feed hoppers feeding two separate series of electrodes arranged vertically in the same frame, thereby greatly reducing floor space per hourly capacity.

1907—Electrostatic Separator. Issued to Greenleaf Whittier Pickard, Amesbury, Mass. Assigned to Huff Electrostatic Separator Company. Material delivered to large revolving horizontal cylinder or electrode while opposite electrode divided into number of quite fine wires. Each subdivision electrode preferably encased in relatively thick glass or other dielectric envelope and arranged at different spacing from large-cylinder repelling electrode, thereby concentrating and intensifying electrotatic charge.

1907—Electrostatic Separator. Issued to Phillip Henry Wynne, Boston, Mass. Assigned to Huff Electrostatic Separator Company. A combination of separating electrodes; a source of potential connection between the same and separating electrodes consisting of segmental contact pieces and brushes furnishing intermittent pulsating charge at separating electrodes.

1907—Method of Electrical Separation. Issued to Henry Azor Wentworth. Assigned to Huff Electrostatic Separator Company, Boston, Mass. Employs principles disclosed in Huff, Wynne, and Pickard earlier patents, particularly in regard to exciting apparatus. Discovered that some materials in mixture adhere more permanently than others to electrodes. Disproved theory that dielectric hysteresis was responsible for adherence of some materials to electrode.

Employs jet of ionized air, preferably appearing as violet illumination, to convey charge to particles on electrode. Conductive particles assuming charge more readily and surrendering it just as readily, are separted from mass more or less by gravity, charges having neutralized each other quickly. Less conductive particles, receiving charge from gaseous jet only on exposed sides and carrying a charge different from that of electrode, adhere to electrode until well out of electrostatic field. In this way a mixture of materials of three or four degrees of conductivity is separated into component parts, according to conductivity of various parts.

Employs electrical stripper to remove particles so slightly conductive that they adhere persistently to electrode.

1910—Apparatus for Electrostatic-Magnetic Separation. Issued to Henry M. Sutton, Walter L. Steele, and Edwin G. Steele, Dallas, Tex. Subjecting particles to action of magnetic field into or through which is passed electrostatic charge or convective current, using pin-point static electrode from which convective current flows and polarizes dielectric particles in influence of magnetic field.

1910—Apparatus for Electrical Separation. Issued to Henry Azor Wentworth, Newton, Mass. Assigned to Huff Electrostatic Separator Company. Production of electrical conditions under which within a portion of electrostatic field the repellent effect, due to electrostatic stress, is with respect to conductive material counteracted or controlled by opposed effect, due to maintenance of spray or jet discharge, leaving in other portions electrostatic repellent effort free to disengage conductive particles from surface of electrode. Using an insulated electo-conductive shield.

It will be seen that during this period, from 1900 to 1910, for the first time the inventors can be classed in four groups, namely:

1. Elmer Gates, Chevy Chase, Md.
2. Lucien I. Blake and Lawrence N. Morscher, Kansas.
3. Henry M. Sutton, Walter L. Steele, and H. M. Steele, Dallas, Tex.
4. The following inventors who were associated with Charles H. Huff, Brockton, Mass.: Clinton E. Dolbear, Hyde Park, Mass.; Greenleaf W. Pickard, Amesbury, Mass.; Philip H. Wynne, Boston, Mass.; Millard Woodsome, Boston, Mass., and Henry A. Wentworth, Newton, Mass.

It will be noted from reading these patents that two general principles were developed. The Sutton, Steele & Steele group used pin-point, screen, or sharp-edge electrodes adjacent to an electrified belt-conveying surface or drum, above which was located an electrically charged screen and a suction device for removing the non-metallic or less conductive particles. This group also gave serious consideration to the combination of magnetic and electrostatic separation in the same separating device. The magnetic particles were first removed and the remaining non-magnetic tailings subjected to electrostatic separation, while the metallic or more conductive particles were discharged at the end of the material-conveying belt.

The general principle employed was to pass pulverized ore or other material under an electrified screen-covered suction device, depending on electrostatic action to repel the metallics or more conductive particles back to the material-conveying belt. The non-metallics or less conductive particles were lifted off the belt and removed by air-suction through the electrified screen openings.

Huff preferred to use round, smooth-surface electrodes and the gravity repulsive action. In other words, the material to be separted was brought into the electrostatic field on a material-conveying revolving electrode of a negative grounded charge, in front of which a positively charged electrode worked on the principle that like charges repel and unlike charges attract. This permitted the manufacture of a separator using iron and steel entirely. It was grounded and made the separator safe for handling by any operator. The material was conveyed by gravity fall from one pair of electrodes to the next and the velocity in the separating field was controlled by the speed of the revolving electrodes. As the material came within the influence of the electrode of opposite charge, it naturally was repelled from the material-conveying electrode to the attracting electrode, and fell by gravity to collection bins.

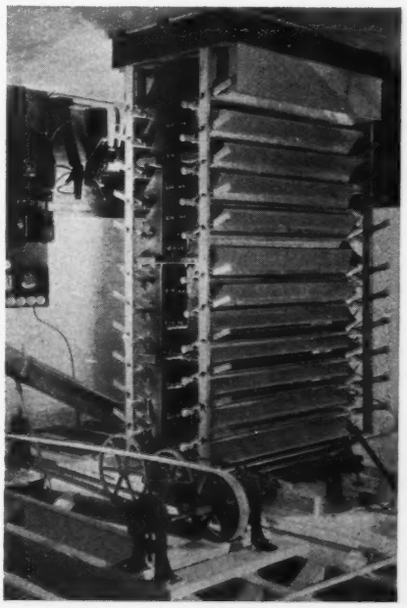
I have not succeeded in locating records or publications referring to the commercial applications made by Elmer Gates or the Sutton, Steele & Steele group involving the ideas expressed in their patents cited in the foregoing. It is possible, however, that some commercial attempts were made to develop these patents and that valuable experience was gained which contributed to the development of the art, publication of which would be interesting.

There is considerable difference between the two principles when it comes to continuous operation, power consumption, current loss through leakage, and other important features controlling continuous operation and separation cost per ton.

Huff began his experience in the art

(*Continued on page* 51)

ELECTROSTATIC SEPARATION is applicable also outside of the mining industry. This installation has been running continuously for the past seven years with great success, removing stones, glass, metallics, and other impurities from mustard seed



Producing Zinc at Trail

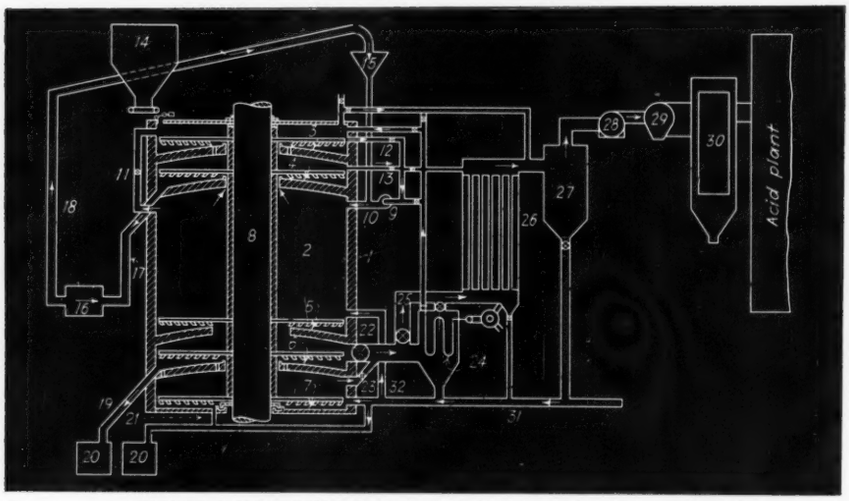


Fig. 1 . . . CONVERTED WEDGE ROASTER used at the Trail plant for roasting zinc concentrates in suspension. For an explanation of the numbers see the legend below

Roasting and Leaching, Electrolysis, Melting, Cadmium Recovery

John B. Huttl
Assistant Editor

THE SECOND principal part of the reduction works of the Consolidated Mining & Smelting Company of Canada, at Trail, B. C., is the zinc plant[1], which operates on the low-acid system. Treatment of Sullivan and custom zinc concentrates involves suspension roasting, leaching and purification, electrolysis, melting, and cadmium recovery. Zinc fume obtained from slag-fuming operations at the lead smelter is treated in a separate plant, known as the oxide leaching plant, and cadmium is recovered electrolytically from oxide and sulphide leaching plant purification residues. Daily output of the entire division is about 400 tons. The three products made are Grade A, or electrolytic, zinc; Prime Western, which is made by adding a specified amount of lead to the electrolytic zinc; and die-casting grade made from specially selected cathodes. The average assay of these products in 1937 was 99.9642, 99.2550, and 99.9927 per cent zinc respectively.

The outstanding development at the zinc smelter is the perfection and adoption of what is locally known as the "burning concentrate roasting process." Previously, roasting was done in 25 standard 25-ft., seven-hearth Wedge furnaces. Eight were recently modified for suspension roasting. Each of these new units is capable of handling without extraneous fuel from 50 to 130 tons of zinc concentrates a day. Essential parts and layout of a complete plant unit are graphically explained in Fig. 1. Concentrates, averaging 2.2 oz. silver per ton, 51.1 per cent zinc, 3.5 per cent lead, 11.4 per cent iron, 32.8 per cent sulphur, 0.14 per cent copper, and 0.16 per cent cadmium, brought to the plant in 80-ton bottom-dump cars, are delivered by belt conveyor to a feed hopper above each furnace and then fed by a short belt through a chute made airtight by a gravity-operated gate to the upper drying hearth. Here, the material is dried by the hot gases circulating between the combustion chamber and the two drying chambers.

The dried concentrate is discharged through a chute at the side of the furnace and fed by a short screw conveyor to a ball mill for disintegration of agglomerations produced by drying, the finished product going via a bucket elevator and screw conveyors to a 25-ton hopper above each furnace. Material withdrawn from the hopper is fed by a belt feeder through an adjustable gate into two air injectors delivering to the burner proper. Air is supplied by a secondary fan. Temperature in the combustion chamber of the furnace is around 1,750 deg. F., and about 60 per cent of the concentrate particles blown in settle out on the collecting hearths at the bottom of the furnace.

When treating extremely wet concentrates, the gases from the upper drying chamber are bypassed directly to the cyclone dust collectors which treat the gases from the roasting furnaces. Finished calcine discharged from the furnace and conveyed by Jacoby rotary conveyors to the leaching plant averages 0.3 per cent sulphide sulphur and 0.4 per cent sulphate sulphur. Under somewhat different plant conditions high sulphate sulphurs may be desired, in which case the calcine would be treated in a sulphating chamber by arranging its discharge from the second collecting hearth to the periphery of the bottom hearth, where it would be rabbled in a strong sulphur dioxide atmosphere,

LEGEND FOR FIG. 1

1. Furnace proper
2. Combustion chamber
3. Drying hearth
4. Drying hearth
5. Collecting hearth
6. Sulphide-control hearth
7. Sulphate-control hearth
8. Air-cooled rotating shaft
9. Circulating and secondary combustion air fan
10. Burner
11. Gas circulating conduits
12. Gas circulating conduits
13. Gas circulating conduits
14. Wet concentrate hopper
15. Dried concentrate hopper with special feeder
16. Ball mill
17. Feed chute and feeder
18. Elevator
19. Chute
20. Jacoby rotary conveyors
21. Chute
22. Main gas outlet
23. Gas outlet from sulphating chamber
24. Waste-heat exchanger
25. Bypass conduit
26. Waste-heat boiler
27. Cyclone dust collector
28. Fan
29. Balloon flue
30. Cottrell plant
31. Screw conveyor
32. Elevator serving sulphating chamber

[1] Operations in the lead plant at Trail were dealt with in *E. & M. J.*, June, 1938.

in part diverted from the combustion chamber to maintain an approximate temperature of 900 deg. F.

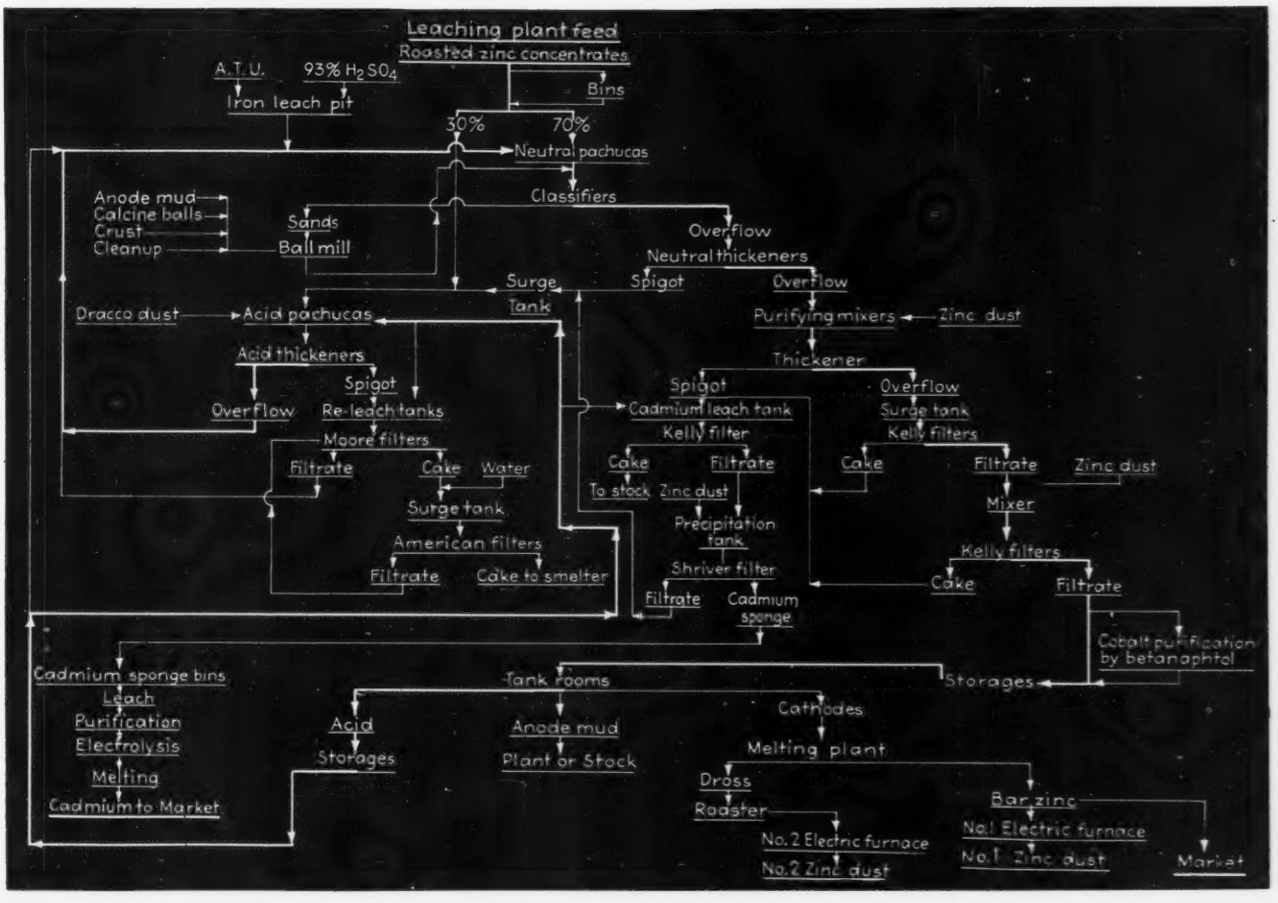
Gases containing 9 per cent sulphur dioxide and a dust burden of from 30 to 40 per cent of the furnace feed leave the interior of the furnace through an opening at the bottom of the furnace and pass successively through a 300-hp. Stirling boiler of the water-tube type, a cyclone dust collector which removes from 85 to 95 per cent of the dust contained, and a Cottrell treater. If concentrates of insufficient thermal value are treated, the furnace gases first pass through a heat exchanger to preheat the secondary combustion air. The Cottrell treater removes about 95 per cent of the dust still present in the gas leaving the cyclone, which amounts to 4 per cent of the original furnace feed. This makes an over-all dust recovery of 99.5 per cent. The gases, after passing through a scrubbing tower, enter the contact acid plants practically devoid of dust. The boiler receives the gas at 1,600 deg. F. and discharges it at 600 deg. F.

Dust from the cyclones containing 0.7 per cent sulphide sulphur and 3.5 per cent sulphate sulphur in conjunction with the furnace calcine goes via Jacoby rotary conveyors to the leaching plant, and material withdrawn from the Cottrell hoppers, with a sulphide sulphur and sulphate sulphur content of 0.2 and 5.5 per cent respectively, is directed to the acid Pachuca tanks in the main leaching plant by a vacuum conveying system and screw conveyors. More than a pound of steam is produced per pound of concentrates burned.

Extraction of zinc at the main or sulphide leaching plant is accomplished by the continuous double-cycle system. Equipment available in the neutral or purification section includes twelve 10-ft. Pachuca agitators; three Dorr duplex classifiers; a 6x6-ft. ball mill lined with manganese-steel liners and using 2¼-in. cast-iron balls; three 50-ft., nine 40-ft., and four 32-ft. thickeners; sixteen purifying mixers; five 4x10-ft. and nine 5x14-ft. Kelly filters; and two 60-ft., electrolyte (neutral) storage tanks. The acid or extraction section of the plant contains two 60-ft. lead-lined acid storage tanks; seven 10-ft. Pachuca agitators; eight 50-ft. thickeners; a two-basket Moore filter with five 10x24x15-ft. concrete tanks, each basket having 29 8x6 ft. leaves with 12-oz. canvas on cocoa matting; six 8 ft. 6 in. diameter, 6-disk American filters; and seven I-R vacuum pumps driven by 75-hp. motors. Filter frames and central drums of the American filters are of bronze, and the leaves of the Moore filter are constructed of copper tubing with bronze fittings. The pumps operating in the leaching plant are of iron, bronze, hard lead, stainless steel, and some are rubber lined, depending on the character of the solution handled. Fig. 2 shows in detail the treatment the calcine undergoes at the acid and purification sections of the plant.

In the neutral section about 70 per cent of the plant feed, averaging 3.7 per cent lead, 57.3 per cent zinc, 12.8 per cent iron, 0.6 per cent sulphide sulphur, 1.7 per cent sulphate sulphur, and a zinc solubility of 87.5 per cent, is agitated with the acid thickener overflow in Pachucas. After thorough agitation, during which soluble iron, antimony, and arsenic are removed, the mixture goes to three classifiers operating in closed circuit with the 6x6-ft. ball mill. Classifier overflow passes to the neutral thickeners, from which the spigot products go to the acid Pachucas and the overflow is sent to the purification department, where zinc dust is added in two stages. Here it is treated successively in mechanical purifying mixers, thickener, and Kelly filters, the combined solids, thickener underflow, and filter cakes

Fig. 2 . . . FLOWSHEET of main leaching plant treating zinc concentrates at Trail. The main flow of the solution is shown by the heavy lines



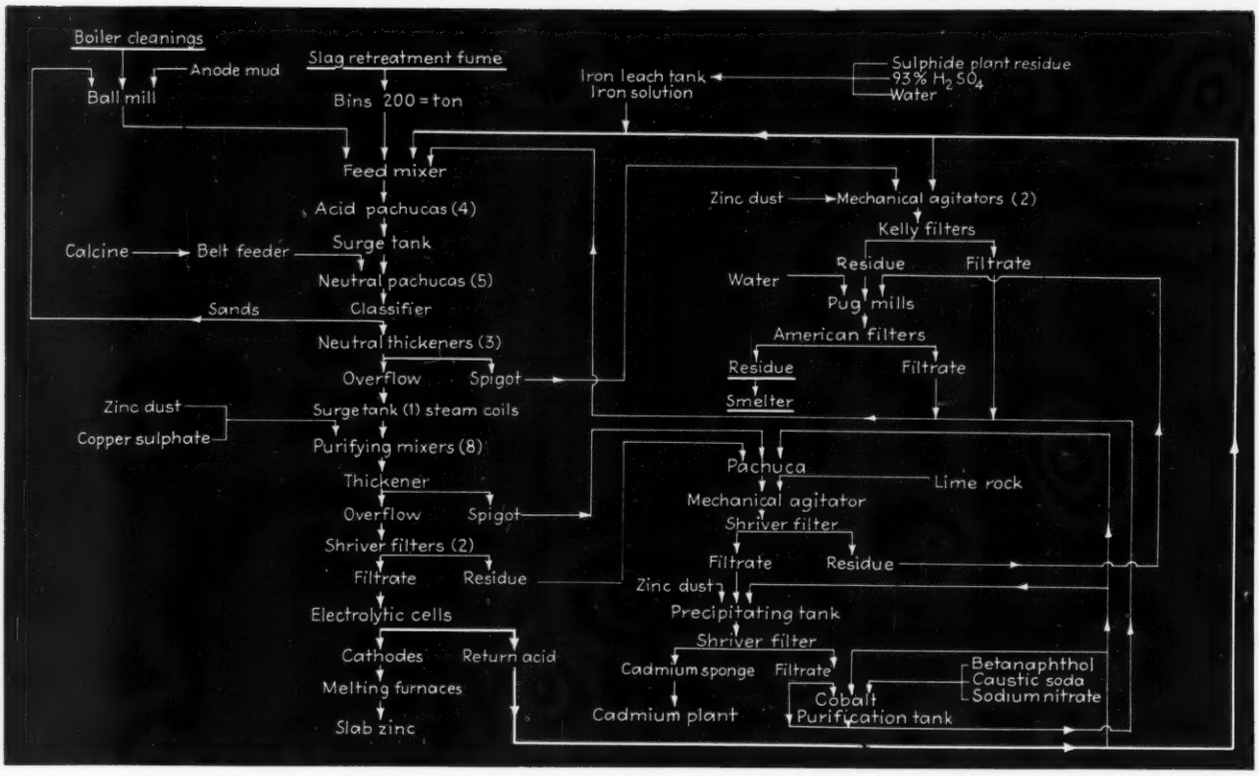


Fig. 3 . . . THE OXIDE LEACHING PLANT in the zinc department at Trail is operated according to this flowsheet. The heavy lines indicate the main solution flow

comprising the feed to the cadmium recovery section. Purified solution is delivered to storage tanks and thence goes to the electrolytic department.

In the acid section of the main leaching plant seven Pachucas treating the neutral thickener underflow and the remaining 30 per cent of the leaching plant feed, including roaster dust recovered at the Cottrell treater, are operated in series. Return acid from the electrolytic department is added to the first Pachuca in amounts that assure an acid content not exceeding 2.4 grams per liter, which gives about 1.8 grams per liter in the last Pachuca. Material discharged from these units is thickened in eight 50-ft. thickeners in parallel. The overflow, carrying 20 grams solids, 1 gram of dissolved iron, and about 0.6 grams acid per liter, joins the calcine in the neutral Pachucas, and the underflow at 40 per cent solids goes to re-leach tanks, followed by primary washing in a Moore filter. Filter cake subsequently is treated on six American filters. The filtrate is returned to the Moore filter, and part of the cake with a moisture content of about 30 per cent is transported in V-cars to the lead blast furnaces. The major portion of the cake is treated in a rotary dryer to about 14 per cent moisture content and delivered to the lead sintering plant. Moore filter washings or filtrate go to the neutral Pachucas. Temperatures of the solutions average 40 deg. C., and daily production of finished electrolyte is about 5,000 water tons (1 water ton equals 32 cu.ft.).

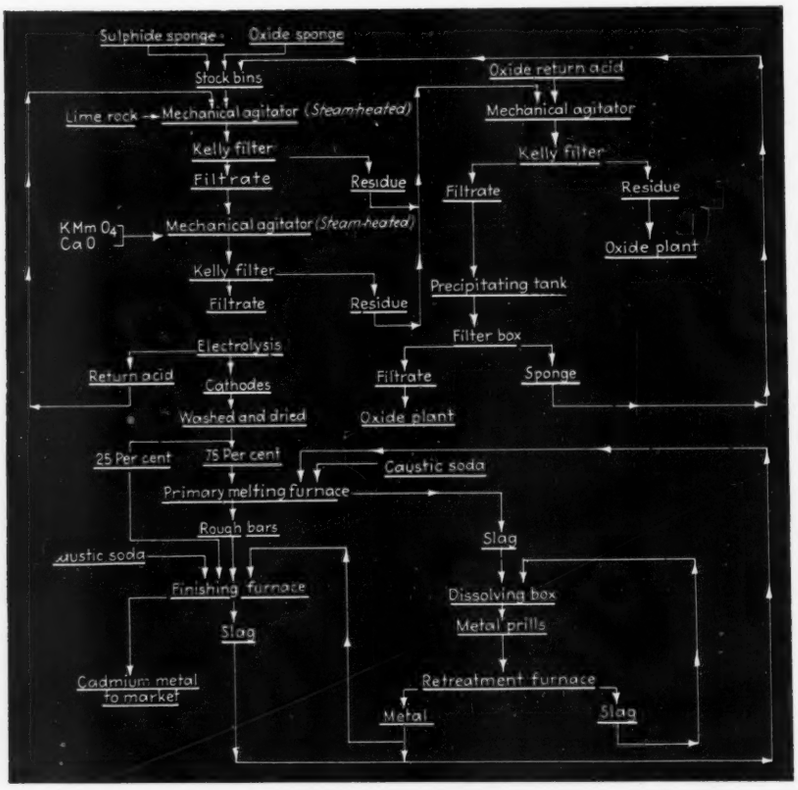


Fig. 4 . . . THE CADMIUM RECOVERY PLANT, the flowsheet of which is shown here, employs electroytic equipment like that used for zinc production

At the acid section of the oxide-leaching plant treating material from the slag-fuming department there are available four 10-ft. Pachuca tanks; one 50-ft. thickener serving as a surge tank between the acid and neutral circuits; and two lead-lined acid-storage tanks 60 ft. by 11 ft. 4 in. The neutral section contains five 10-ft.

Pachuca tanks; a grinding unit comprising a Dorr classifier and a ball mill; five 50-ft. thickeners; seven 10-ft. purifying mixers and one 15-ft. purifying mixer; five Kelly filters with lead-lined shells, 5x14 ft., using F-16 canvas on cocoa matting as a filter medium; four 42-in Shriver presses, each containing 39 plates and 40 frames, with a filter medium consisting of 30-lb. creped Kraft paper on 4-oz. duck, and operating at pressures from 5 to 50 lb. per square foot; two 26x18x23-ft. wooden cooling towers; a 60 ft. by 11 ft. 4 in. wooden storage tank for neutral electrolyte; and two feed bins of 150 and 75 tons' capacity. Plant operations are graphically explained in Fig. 3.

The pulp from the feed mixer composed of oxide fume, return acid from the electrolytic department, iron solution for purification, and anode mud goes to four acid Pachucas in series, and then to a 50-ft. thickener acting as a surge tank before entering the five neutral Pachucas. Calcine is added to the neutral Pachucas (about 37 tons per day) for neutralization of the acid circuit. Material discharged from these units is delivered to a Dorr classifier, the sands returning to the feed mixer after treatment in a ball mill, and the overflow going direct to three neutral thickeners.

The underflow from these thickeners, comprising the lead residue, is given a partial leach with return acid in two mechanical agitators to reduce the percentage of acid soluble zinc. Zinc dust is added to save press and pump corrosion. The pulp is filtered in five Kelly filters and the cake repulped with water and filtered on four American filters. Filtrate from the Kelly and American filters is pumped back to the feed mixer, and the final filter cake is sent to the lead smelter.

Overflow from the neutral thickeners passes to a surge tank heated with steam coils, then to eight purifying mixers, where zinc dust and copper sulphate are added, and a 50-ft. thickener delivering the overflow to two Shriver presses. This purification is made at temperatures ranging from 65 to 70 deg. C., and the amount of zinc dust added to the purifying mixers varies from 3 to 4 grams per liter. The underflow and Shriver cake (copper-cadmium-cobalt residue) pass to a leaching and precipitation plant producing cadmium sponge. This unit contains a Pachuca tank, a mechanical agitator, two Shriver presses, and a precipitating tank. The oxide-leaching plant produces some 1,500 water tons of finished electrolyte a day.

The electrolytic department contains 2,340 cells. Of these, 1,018 cells have 24 lead anodes and 23 aluminum cathodes spaced at 3 in. centers, and the remainder, or 1,322 cells, have 14 anodes and 13 cathodes, some spaced at 4 in. and some at 3½ in. centers. One half of the cells are of Prodorite construction, the others being made of concrete and lined with rubber. The lead anodes are ¼ in. thick and have an area of 10.9 sq.ft., of which 9.2 sq.ft. are submerged, and the aluminum cathodes have an area of 12 sq.ft., with 9.4 sq.ft. submerged, and are 3/32 in. thick. Current density is from 30 to 45 amp. per square foot, and voltage drop between cells is 3.6. Electrolyte flowing to the cells contains 125 grams of zinc per liter, and acid electrolyte 105 grams free sulphuric acid per liter. Cell operation is at 35 deg. C., and cathodes are removed and stripped each 24 hours. The cells are cleaned on a ten- to seventeen-week cycle, the anode mud comprising manganese dioxide and lead peroxide either being stored or returned to the ball mill circuit in the leaching plant. Electrical equipment consists of thirteen double motor-generator sets, each 1,100-kw.; ten rotary converters, each 2,475 kw.; and three mercury-arc rectifiers of 5,600 kw. each.

Of the five reverberatory furnaces available for melting cathode zinc, four are used for melting cathodes, and the fifth is used for treating drosses. The cathode-melting furnaces have a capacity of 100 tons per day each, the dross-melting furnace has a capacity of 25 tons per day, and all are hand-fired with coal. Molten zinc is ladled into molds, and drosses after removal of chlorine by roasting are reduced in an electric arc furnace to zinc dust, which is used for solution purification.

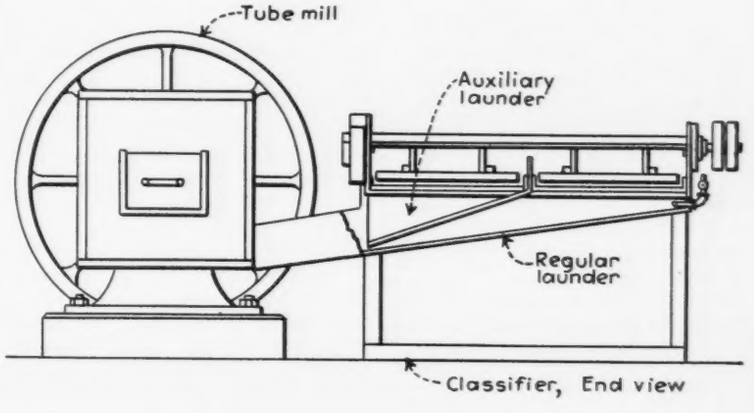
Fig. 4 shows in a self-explanatory manner the operations at the cadmium-recovery plant. Electrolytic equipment is similar to that used for zinc deposition. In view of the fact that cadmium tends to form trees, a low current density of 4 amp. per square foot is required. Optimum temperature for electrolysis is 30 deg. C. Cathodes and trees are melted in two stages under caustic soda into pencils, balls, bars, anodes, and sheets. Slags are acid-leached in the overflow of the cadmium electrolytic units. The cadmium produced is 99.968 per cent pure.

▼ ▼ ▼

Auxiliary Launder on Classifier Improves Grinding

THE MILL superintendent of a cyanide plant in Equador, S. A., was recently confronted with a problem when trying to improve grinding in the tube mills. One cause for poor performance was the smallness of the circulating load, but attempts to increase it were frustrated by the fact that, because of fixed and inadequate inclination, evidently based on early tube-mill practice, the launder from the Dorr rake classifier discharge into the tube-mill feed box would carry no more, unless much more diluent (solution) was added at the head of the launder. To do that meant undesirable pulp dilution in the mill, reduced grinding, and increased pebble and liner wear.

The difficulty was finally solved by the simple expedient of putting in a small, steep auxiliary launder, as shown in the accompanying sketch, to take the sand from the half of the classifier nearer the mill, which delivered into the regular launder but terminated a few inches above it, so as to allow the sand from the other half of the classifier to pass beneath it. Thus it was possible to increase the circulating load to a maximum, and at the same time to adjust diluent addition exactly to meet the grinding requirements.



Structural Control Of Ore Deposits In The Tri-State Zinc and Lead District

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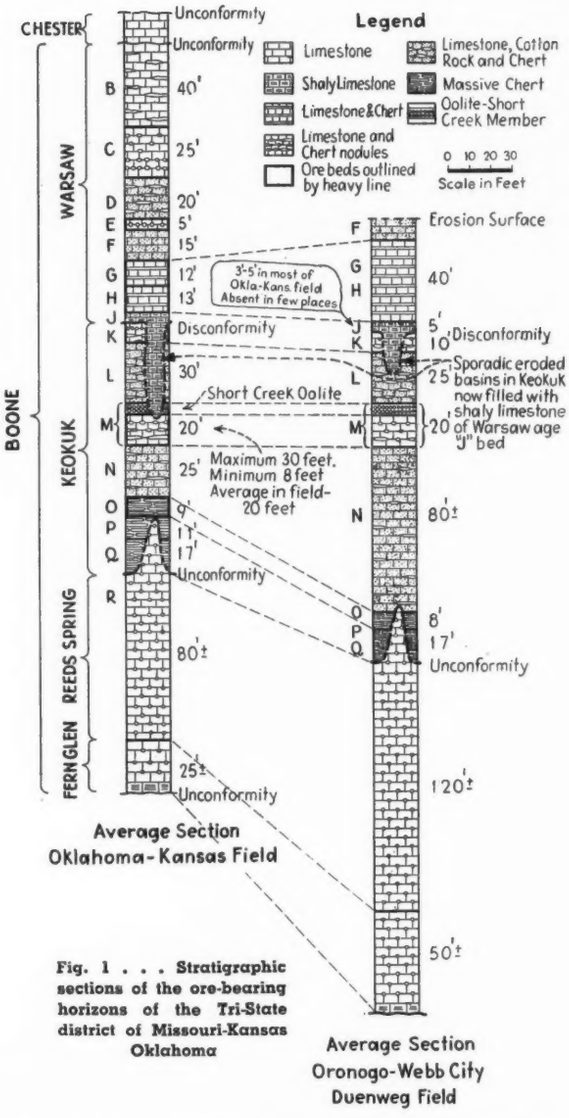


Fig. 1 . . . Stratigraphic sections of the ore-bearing horizons of the Tri-State district of Missouri-Kansas Oklahoma

THE TRI-STATE zinc and lead district, an area of about 2,000 square miles, comprises adjacent parts of southwestern Missouri, southeastern Kansas, and northeastern Oklahoma (Fig. 2). The value of its mineral production to date exceeds $850,000,000, more than half of which has come from the Oklahoma-Kansas portion of the district in the vicinity of Picher, Okla., where mining operations were started about 1916.

The Boone member of the Mississippian series is the principal ore-bearing formation throughout the region. In the Missouri part of the district, the Boone is largely the surface formation, with a present thickness of from 100 to 300 ft., the upper part having been eroded. In the Oklahoma-Kansas area, the partly eroded Boone is approximately 400 ft. thick and is covered with more recent formations from a depth of a few feet to several hundred feet. (See Table II and Fig. 1.) This member evidently was deposited as limestone, but as a result of subsequent deformation and chertification, it is now composed of limestone, cotton rock, chert, and dolomite. (See Table II and Fig. 1.) Minor orebodies are in places found above the Boone in the Upper Mississippian-Chester and in the Pennsylvanian-Cherokee formations.

A generalized geologic section of the formations in the Tri-State district is shown in Table I.

In the Tri-State district the Boone formation is separable into more than sixteen beds which are fairly uniform in thickness and have distinctive characteristics. (See Table II and Figs. 1, 8, and 9.) However, in many scattered areas throughout the district erosion and solution in medial Mississippian times removed many feet of the strata comprising K, L, and M beds. Greenish, shaly limestone of Warsaw age was then deposited widely on the rough Keokuk surface. In most of the region it is less than 5 ft. thick, but it fills many scattered depressions in the Keokuk formation, some of them to a depth of 50 ft. This deposit, from 0 to 50 ft. in thickness, is designated as J bed. It fills eroded depressions in K, L, and M beds in the Big John, Central, Beaver, Woodchuck, and numerous other mines in the Tri-State district.

Beds K, L, and M were more easily soluble than any other part of the Boone formation. Nearly all the sink holes in the district may be attributed to the solution of the limestone in these beds.

The sequence of significant events in this region, as revealed by the geological evidence, is as follows:

1. Regional deep-seated deformation of all the formations, including the Boone limestone, which produced flexing and opening of the strata and the formation of countless fissures and shear zones. These strata vary from about 1,200 to 2,000 ft. in thickness and overlie the old basement rocks of the Ozark Uplift. It seems probable that large shear zones, such as the Miami, Bendelari (See Fig. 5), and others, are pronounced structural features in the old basement rocks nearly vertically below their trends in the Tri-State district. In some areas erosion removed many feet of the Keokuk formation before the Warsaw forma-

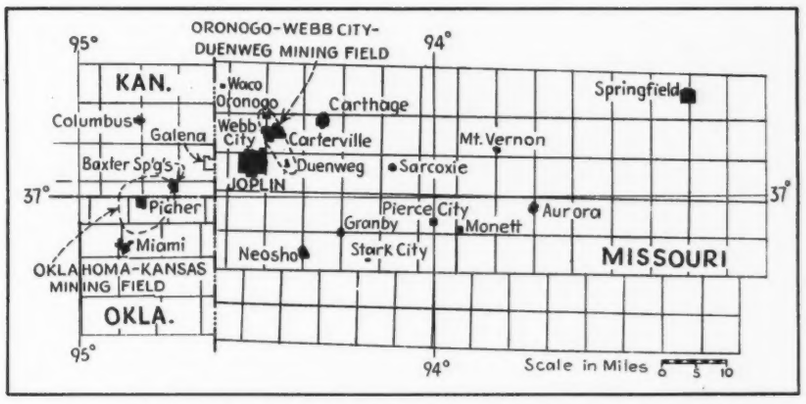


Fig. 2 . . . AN INDEX MAP of the Tri-State zinc and lead field of Missouri-Kansas-Oklahoma

Table I—Generalized Geologic Section in Tri-State District

System Series Carboniferous	Character of Formations	Thickness in Feet
Pennsylvanian	Shale and sandstone (Cherokee)	0– 250
Mississippian	Chester series — limestone, sandstone and shale. Occurs as outliers, mainly in sink holes in Missouri, with an average thickness of about 20 ft. Overlies the Boone in the Oklahoma-Kansas field.	0– 50
	Boone formation — limestone, cotton rock, dolomite and chert — originally all limestone.	200– 400
	Shale (Northview or Chattanooga). Absent in most of district	0– 10
Ordovician	Largely dolomite	700–1,000
Cambrian	Dolomite and sandstone	0– 800
Pre-Cambrian	Granite, and probably other igneous rock that intruded the granite.	

Table II—Stratigraphic Classification, Boone Formation—Tri-State District

Bed	Thickness in Feet	Characteristics
		Warsaw formation — Thickness variable everywhere in the Tri-State district, due to erosion. (Fig. 6.) In the Oklahoma-Kansas mining field erosion was confined largely to the strata above C bed.
B	0–40	Limestone and dolomite, light gray and brown; some white and blue chert.
C	0–32	Gray to brown limestone; white and blue chert; commonly more chert in basal 10 ft.
D	0–25	Limestone, cotton rock, and chert; limestone light brown; cotton rock, white; chert white and dense; contains commercial orebodies in a few mines.
E	0–8	Limestone and chert; limestone brownish locally; chert gray and brown; an important ore bed in a few mines.
F	0–15	Limestone, light brown; chert; white cotton rock.
G	0–20	Limestone, gray and brown; mostly thin-bedded; chert, brown and gray to white; resembles H bed; an important ore horizon.
H	0–20	Limestone, gray and brown, and chert, brown and gray, in alternating bands, mostly 2 to 5 in. thick; an important ore horizon in many mines and mined with G bed in some areas.
J*	0–50	Limestone, brownish to very dark gray, slightly greenish and shaly; contains some chert; very glauconitic. Usual thickness 3 to 5 ft., but absent in a few localities where the Keokuk formation remained above normal elevation of this bed. (See Fig. 1 and the fourth paragraph on page 46 regarding this bed and eroded basins in the Keokuk formation.)
		Bottom of Warsaw — Very irregular in thickness in many localities.
		Disconformity.
		Keokuk formation.
K	0–10	Limestone, gray, crinoidal; contains abundant nodules of chert; an important ore zone
L	0–30	Limestone, gray, medium to coarse-grained, massive; and massive gray chert or cotton rock.
M	8–30	Limestone, gray; and top 4 to 6 ft. oolitic (Short Creek), but oolitic texture is seldom recognized in areas of mineralization; chert occurs largely in rounded nodules; the important ore horizon in the Oklahoma-Kansas mining field. Solution and erosion removed parts of beds K, L, and M in some areas. (See text.)
N	20–80	Limestone, massive; gray, somewhat mottled, chert, occurs in bands and in large nodules 1 ft. thick by 5 to 15 ft. in diameter. This bed is 20 ft. thick in most of the Oklahoma-Kansas mining field and is generally barren. It gradually thickens to the east, being about 50 ft. in the vicinity of Baxter Springs, Kan., and about 80 ft. thick around Stark City, Mo., and is an important ore horizon in some mines in these localities.
O	8–9	Some limestone and abundant chert; gray, dense, in bands and round, flat nodules; an important "sheet-ground" ore zone.
P	8–11	Chert, gray, in bands, and in large flat nodules; some limestone; mineralized locally.
Q	17–18	Chert, gray, dense; and limestone, gray, massive; mineralized locally. Beds N, O, P, and Q are equivalent to the Grand Falls Chert horizon.
		Unconformity.
	80–120	Reeds Spring formation. Limestone, dark bluish, medium to fine-grained; thin to medium beds and abundant chert occurs as irregular-shaped nodules and thin beds alternating with the limestone.
R		An important ore bed 7 to 10 ft. thick a few feet below the top of this formation in the vicinity of Oronogo, Mo. This bed has many characteristics in common with a similar ore bed in the Paxon, Garrett, and other mines in the Oklahoma-Kansas field.

* In the above classification of beds the letter "I" was omitted because it is so easily confused with the numeral 1.

tion was deposited. (Table II, Fig. 1.)

2. Partial to complete chertification of limestone in the zones of deformation; and conditioning of the residual limestone into "sponges" for the ore-bearing solutions. The unaltered limestone remained barren even in zones of deformation.

3. Second period of adjustment, with formation of new fissures and shear zones in trends of earlier zones of adjustment and reopening along contiguous beds.

4. Deposition of the jasperoid and the ore minerals in favorable reservoirs.

5. Further deformation, subsequent to the deposition of the ore, shattered some of the smaller orebodies and produced a few fractures in the larger ones. This deformation is particularly noticeable in partly chertified limestone contiguous to the larger ore-bodies.

All the beds of the Boone formation are barren of mineralization except where deformation created structures favorable for ore reservoirs. In these areas the ore is confined almost exclusively to one or more of the favorable beds, such as E, G, H, K, M, O, P, and R beds, as shown in the stratigraphic section. (See Table II and Figs. 1 and 8.) Beds M, K. O, and R, in the order named, are the most important hosts for ore. In zones of strong fissuring, the beds from E to O, inclusive, are in places all ore-bearing. This was so in the Pioneer, in the southwestern part of the Oklahoma-Kansas field, where the orebody bottomed in O bed and was mined through a vertical range of 125 ft. and a length of more than 1,000 ft.

Structural deformation, of course, is extremely important in the localization of orebodies in most parts of the world, as it creates the channelways for mineralizing solutions and forms many of the ore reservoirs. In the Tri-State district its influence is striking, as the degree and character of structural deformation appear to have controlled the size, shape, and richness of every ore deposit. Without deformation there would probably have been no ore concentration.

In the search for ore in the Tri-State district, the structural features of importance were determined largely by contouring convenient key strata and by mapping the shear zones in the underground workings. Key strata were established by examining cuttings and logs from many thousand churn-drill holes and by underground observations. Drill holes were spaced 100 ft. to one-fourth mile apart, depending on the character of the flexing. As minor flexing was of great importance in creating ore reservoirs, the contours were drawn at vertical intervals of 5 ft. They show that nearly all the ore-bodies trend with the strike of the structure contours. The few exceptions are due to local conditions.

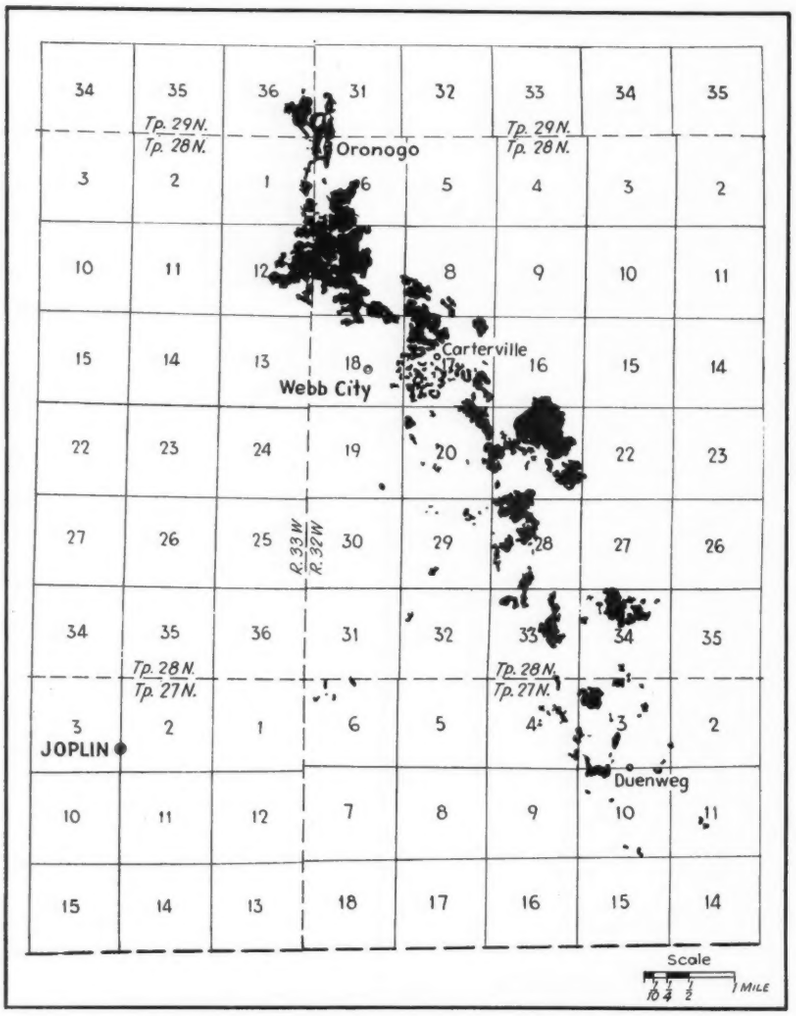


Fig. 3 . . . UNDERGROUND WORKINGS of the Oronogo-Webb City-Duenweg mining field, in southwest Missouri in the Tri-State district

The subsurface structure of the area in the Tri-State district in which the orebodies have been found may be likened to that of an oil field comprised of numerous domes, basins, anticlines, synclines, and allied flexures. This comparison is strikingly noticeable in the Oklahoma-Kansas field. There nearly all the structures are relatively small, and differ greatly in both vertical and horizontal dimensions. In area they range from a fraction of an acre to many acres. In vertical deformation they range from a few feet to about 100 ft. Maximum displacement of strata in the Oklahoma-Kansas field is 350 ft. (See Fig. 5.)

The main part of the Oklahoma-Kansas field is a roughly circular area in which the rocks were compressed and shortened in a general north-south direction and elongated in an east-west direction. This deformation relieved the stresses by flexing the strata and by forming northwesterly and northeasterly trending shear zones. Widespread shattering of marked intensity occurred contemporaneously. Rotational stresses accompanying the general adjustment produced curvilinear flexures and shear zones, which became the loci of many ore deposits of curved shape. (See Fig. 7.) Another important feature of the deformation was the opening of the strata to permit formation of bedded deposits, particularly in O bed in the south-central part of the field. Deformation was more intense and of greater vertical relief in the Oklahoma-Kansas field than in any other part of the district that has been studied to date.

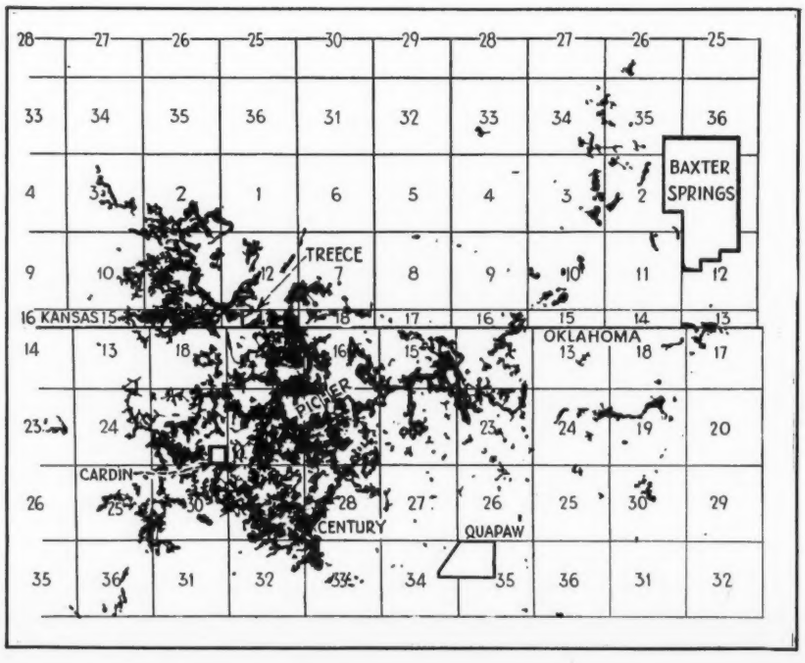
The Oronogo-Webb City-Duenweg mining field is made up of a series of gently pitching flexures and shear zones of various types. In its length of eight miles the strata drop to the northwest 100 ft. in elevation. Most of the higher Boone strata have been eroded, and the ore is confined largely to the lower favorable beds such as O and R beds. In several mines under and south of Oronogo R bed is a particularly favorable ore reservoir.

Zones of intense deformation where the deformed and shattered strata moved from a few inches to several feet, instead of many feet, were particularly favorable ore reservoirs. Structural displacement of many feet generally lacked the intense shattering and opening of beds which are so essential in localizing these orebodies.

Fissure or shear zones are numerous throughout the district and range from a few inches to several hundred feet in width and from a few feet to several miles in length. The fissures are generally readily discernible in the more brittle incompetent strata. Their equivalent in limy or shaly strata may be narrow corrugations from a fraction of an inch to several inches deep and many feet long.

Most of the ore in the Tri-State dis-

Fig. 4 . . . MINED AREAS in the Oklahoma-Kansas mining field, in the Tri-State district



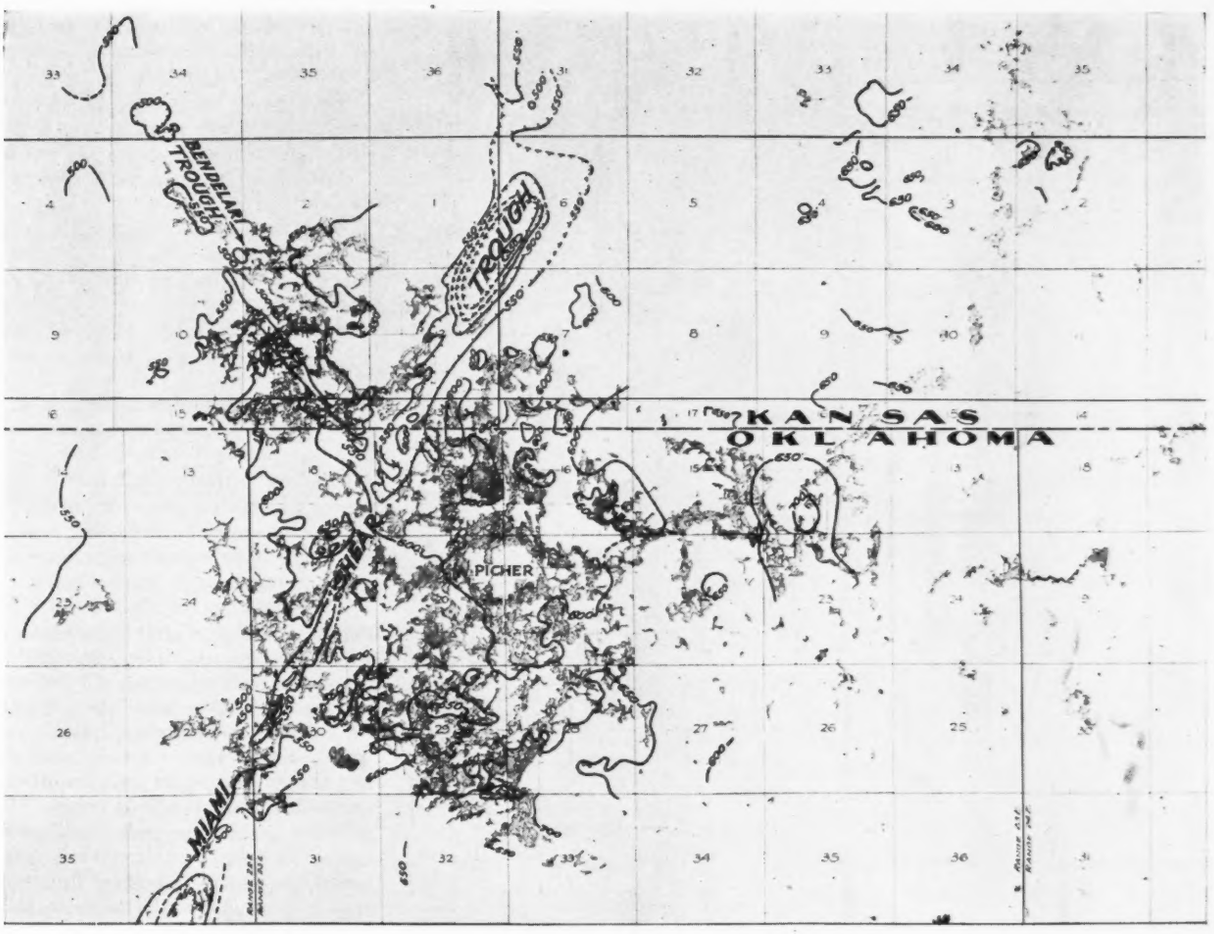


Fig. 5 . . . STRUCTURE CONTOURS on *M* bed, represented by full line in the Oklahoma-Kansas mining field.

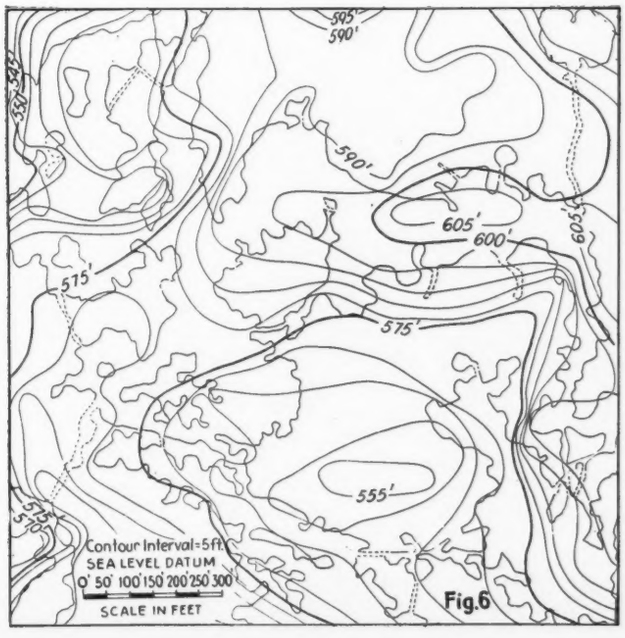
trict has been produced from two main areas:

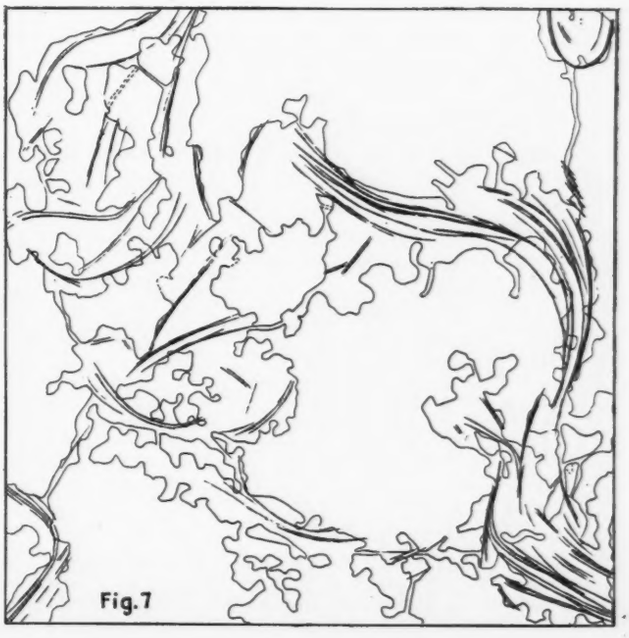
1. The heart of the Oklahoma-Kansas field, about eighteen square miles in extent. (See Fig. 4.)

2. The Oronogo-Webb City-Duenweg field, about eleven square miles in extent, which trends northwesterly from a point six miles east of Joplin. (See Fig. 3.)

The remainder of the ore was produced from innumerable mineralized areas, ranging in extent from a few square feet to several hundred acres, scattered throughout the district. All

Fig. 6 . . . STRUCTURE CONTOUR map of Woodchuck mine, near Cardin, Okla., in Oklahoma-Kansas mining field. The relation of structure contours on *M* bed to mined orebodies is indicated. Fig. 7, shearing in the Woodchuck mine





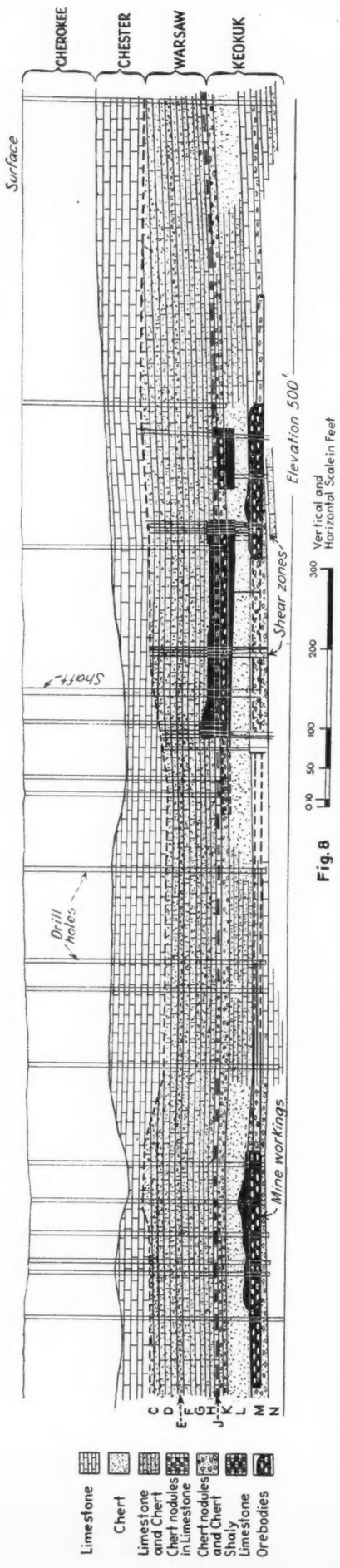


Fig. 8 . . . VERTICAL SECTION across the Bendelari mine in the Oklahoma-Kansas mining field. Notice the nearly vertical shear zones and their relations to the orebodies. M bed is certified in and near the orebodies and is limestone in the long drift between them

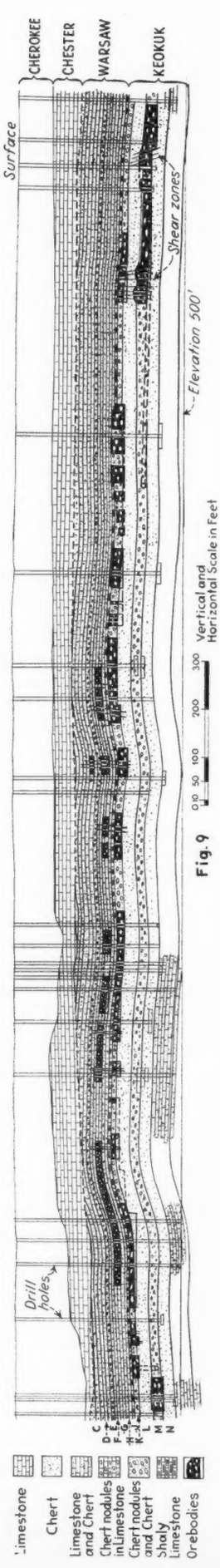


Fig. 9 . . . VERTICAL SECTION across the LaSalle-Goodwin mines in the Oklahoma-Kansas mining field. The ore transects the strata, being in the lower beds in the limbs and in the higher beds near the crests of the anticlinal flexures

the orebodies, localized by some sort of structural deformation, are surrounded by barren areas, largely of limestone and chert, in which there is little or no pre-mineral deformation.

Throughout the district the orebodies localized only within zones of pre-mineral deformation. These deformed, competent and incompetent, strata comprise flexures and shear zones of all types and sizes. The competent beds are usually massive and devoid of mineralization, except where the stresses were of marked intensity. The incompetent, relatively thin-bedded strata, containing numerous stylolite partings, generally metamorphosed into exceptionally favorable reservoirs for the ore-bearing solutions. In many cases, the visible shearing is confined to the incompetent beds, its trace in the competent beds directly above and below being nearly imperceptible.

The structural conditions most favorable for major ore reservoirs are wide, strong, and intensely shattered shear zones contiguous to deformed strata that have been opened along the bedding planes and stylolite partings. Where these conditions are present, the ore reservoirs are combinations of the fissure and bedded types. Single fissures lacked the structural conditions, particularly shattering, necessary to produce important ore reservoirs. Orebodies in or near them are generally small and unimportant.

In horizontal strata, the ore is usually found in nearly vertical shear zones; it is continuous through several beds in the very strong shears and is confined to one or more incompetent beds in shears of less strength and intensity. (See Figs. 8 and 9.)

In flexed strata the ore may be found in the crests of domes and anticlines, in the bottoms of basins and synclines, on any part of these folds, and in any allied structures where adjustment occurred. It is evident that both the chert and the ore mineralization generally followed the paths formed by the consecutive stresses. These stresses transected the strata successively upward and outward from the bottom of the basin or synclinal flexures, and inward and upward toward the apex of the dome and anticlinal flexures. (See Fig. 9.) Ore deposits in basin-like flexures are less common than the dome or anticlinal flexures, but this type of deposit is found in the Westside, New York, and other mines throughout the districts.

The factual evidence summarized in the preceding paragraphs should be recognized in any search for orebodies in this region. A thorough knowledge of the practical stratigraphy of the Boone is a requisite in preparing the structure maps that are essential as an aid in determining the ore-bearing areas. Each tract of land is a problem in itself, and its mineral worth is

Fig. 10 . . . A POLISHED SPECIMEN from the Foch mine, in the Oklahoma-Kansas mining field, showing jasperoid and sphalerite cementing chert and replacing limestone (From Boodle Lane Museum)

determined gradually from drill-hole data and underground observations. This method has been applied in the study of many areas in all parts of the Tri-State district, including the Oklahoma-Kansas and Oronogo-Webb City-Duenweg mining fields, and numerous less important localities.

This paper is a summary of the data regarding the structural control of the ore deposits of the Tri-State district. The subject was mentioned in the earlier publications listed in the attached bibliography. These scattered references have been collected here and combined with the new observations that have been recorded in the progressive study of these ore deposits.

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Quicksilver in Arkansas

CINNABAR was discovered near the southern border of the Ouachita Mountains, in southwestern Arkansas, in 1930, according to J. C. Reed and F. G. Wells in United States Geological Survey Bulletin 886-C, just published. The belt in which it is now known has a length of more than 25 miles from east to west, and in most places is less than a mile wide, although it has a maximum width of about 6 miles.

The principal rocks exposed in the district are shale and sandstone of the Stanley, Jackfork, and Atoka formations, of Pennsylvanian age, which aggregate many thousands of feet in thickness. The three formations occupy several east - northeastward - trending belts and have been deformed by close folding and thrust faulting.

Most of the cinnabar deposits are in a northward-overriding thrust block that is cut by tear faults and is deformed and minutely fractured by cross folds. The cross folds and the tear faults appear to have been formed during the thrusting.

In the eastern part of the district the cinnabar is found in the Jackfork sandstone; throughout most of the rest of the district the ore occurs principally in the Gap Ridge sandstone member of the Stanley shale, but locally it is found at other horizons in the Stanley and in the overlying Jackfork sandstone.

Most of the cinnabar fills fractures related to the cross folds, but certain tear faults may also be worthy of prospecting. Locally, cinnabar is disseminated through the sandstone. The cinnabar is invariably associated with the more widespread clay mineral dickite. The linear distribution of the ore deposits is believed to have been due to the ascent of mineralizing solutions along or just above the thrust faults until the solutions reached fractured sandstones, whence they followed these permeable beds toward surface.

Because of the low relief, the scarcity of good outcrops, and the heavy brush cover, surface prospecting is difficult. Surface prospecting and especially underground prospecting are hampered by the irregularity of the fracture zones and the irregular distribution of the ore within the zones.

Geologic indications appear to warrant further prospecting and development in favorable areas. It seems likely that in a time of national emergency, when cost is no obstacle, the Arkansas district can produce a large amount of quicksilver. The metal probably can be produced at a profit under conditions similar to those of 1936, provided the enterprise is not burdened by too great an expense in the finding of orebodies similar to some already mined.

▼ ▼ ▼

Electrostatic Separation

(*Continued from page* 41)

of electrostatic separation with the invention of Clinton E. Dolbear in 1901, as a basis of his operations in forming the American Mining & Metal Extraction Company, out of which, in 1905, developed the Huff Electrostatic Separator Company, of Boston.

The design of the Huff separator permitted machines to be constructed with separating electrodes 6 ft. long and a capacity about the same as tables and magnetic separators at that time.

Huff and his associates made a study of all the patents and selected the repulsive idea as being most suitable for commercial application. They realized that the chief weakness of electrostatic separation, up to that period, was the friction and induction sources of current supply. Huff selected engineers who devoted most of their time up to 1908 in perfecting a more reliable source of static current supply. The work of Dolbear, Wynne, Pickard, Woodsome, and Wentworth, as indicated by a careful reading of the patents issued to them and assigned to Charles H. Huff or the Huff Electrostatic Separator Company, will show the leadership and sound engineering principles applied to the art of electrostatic separation.

The contribution of Huff is more remarkable because he was not an engineer. He made his success in the real estate business and accumulated considerable wealth. He was an excellent organizer and a financial genius. Publications and available records show him to be outstanding in the development of the art. Those who knew him often called him the grandfather of electrostatic separation. He was a business man of strong character and personality and had great confidence in the future of mining and electrostatic separation as a means of recovering valuable minerals for the benefit of mankind.

Economy In Dump Treatment

A case where the grade of the material permitted only the fines to be handled

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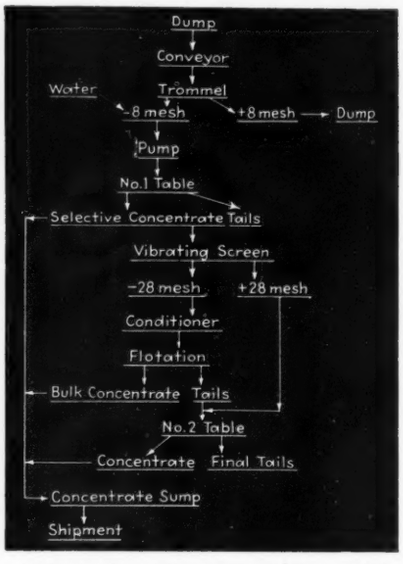
THE DYNAMITE Metals Company was formed to lease and operate the dump of the Santiago Metals Company on Mount McClellan, eight miles southwest of Georgetown, Colo., at an altitude of approximately 11,00 ft. In addition to the dump, the lease included the mine shop and buildings, the mill, a bunkhouse, and other surface equipment. The leasing company was organized with H. N. Edmondson as manager. He was faced with the problem of treating the dump with only a limited amount of working capital. His judgment was that the grade in gold and silver would not permit the ordinary crushing and grinding costs to be obtained and at the same time return a reasonable margin of profit. He therefore proposed to treat only the fines, which were estimated to be approximately 40 per cent of the total tonnage. These fines also carried a higher assay than the average of the dump as a whole.

The elements of the problem were as follows: The dump, containing an estimated 50,000 tons of reject rock from old and recent mining operations, was about 100 yd. from the mill, at roughly the same elevation. A previous reclaiming operation, using a dragline, had made a cut through the middle of the dump, parallel with the length of the mill. The millsite was on a 45-deg. slope with ample space for tailings disposal in a long flat valley below. The water supply came from a creek 800 ft. below and a mile and a half distant from the mill.

Milling equipment available consisted of a jaw crusher, a coarse-ore bin, a 60,000-gal. water-storage tank, a No. 56 Marcy ball mill, an Akins 54-in. low-weir classifier, two No. 6 Wilfley tables, a conditioner, a five-cell Denver Sub-A flotation machine, a thickener, a filter, and pumping equipment.

After study and some experimentation it was decided that the most economical recovery would be given by the following flowsheet: Fines would be delivered from an 8-mesh trommel to the mill in a 30-35 per cent pulp. It would first be put over a primary table, making a rougher concentrate. Table tails would be sent to a conditioner, flotation reagents added, and the pulp floated at 25-30 per cent dilution in a rougher-cleaner



FLOWSHEET adopted by Dynamite Metals Company for treating dump

circuit. Flotation tails would be retabled as a pilot operation. Table and flotation concentrates would be mixed in a concentrate sump and allowed to settle and drain before shipment. In this way the expenses of crushing, grinding, classification, thickening, and filtering would be eliminated. It was conceded that this method of treatment might not be metallurgically ideal, but it was believed to be the treatment which would yield the greatest net operating profit under the conditions.

With this tentative flowsheet determined, the next problem to be attacked was that of handling and sizing the dump material. From the topography of the dump and its relation to the mill, it was thought that the sizing trommel could be placed so as to utilize a gravity flow of water from the mill storage tank and a gravity return of the sized pulp to the mill, either through an open launder or a pipe line. A 30-in. by 6-ft. trommel with an 8-mesh screen was obtained, and the discharge altered to take care of a reject of any size. This was set in a cradle with a slope of one inch to the foot and driven by a chain through a countershaft.

For the season's operation it seemed best to work the portion of the dump on the west side of the old cut. A 24-in. conveyor belt 75 ft. in length was erected from the toe of the west side to the trommel station on the brow of the east side (see the sketch). A hopper was built at the lower end of the conveyor, and a system of chutes designed to feed into the hopper. This chute system was so flared that four men had room to muck into it, and served the entire toe of the dump.

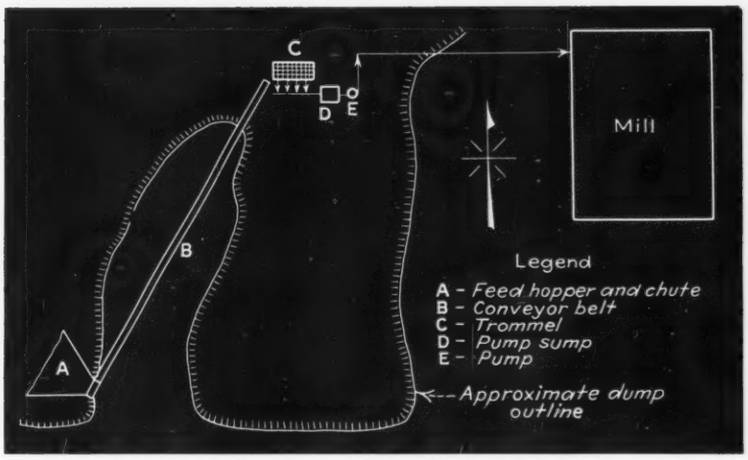
Both conveyor and trommel were controlled from the same switch, although driven by separate motors. The conveyor belt was driven at 60 f.p.m. and the trommel at 10 r.p.m.

On testing the scheme, much difficulty was experienced in obtaining a positive and steady pulp flow to the primary table, because of insufficient fall in the return pulp line. The solution finally reached was the installation of a 1-in. centrifugal sand pump operating from a 4x4-ft. sump. With the proper bypassing arrangements, this was found to work satisfactorily with the dilution used.

From the lessons learned from the present season's operation the recommendation has been made that the trommel be placed at the toe of the dump next year and be fed entirely by chutes and hopper, thus doing away with the conveyor system. Inasmuch as experience shows that the pulp will have to be pumped in any event, this change will simplify the work. The delays already encountered this season made it inadvisable to attempt to make this change now.

The principal difficulty in milling was the tendency of the coarser material in the primary table tails to build up in the conditioner. This was finally overcome by installing a wet vibrating screen at this point, the separation being made at 28 mesh and the oversize being bypassed around the flotation circuit to the pilot table. The amount of material thus bypassed is somewhat less than 10 per cent. Flotation reagents used in treating this oxidized dump ore are sodium ethyl xanthate, copper sulphate, pine oil, and Barrett's No. 2. Although the ore is characterized by a large percentage of barren pyrites, a bulk concentrate is made in flotation, and the primary table is depended on to make a selective concentrate to bring the shipments up to grade. The over-all ratio of concentration is approximately 12 to 1. About 8 tons of concentrate is made every 24 hours.

This description is given to illus-



LAYOUT of plant for retreating dump material

trate a method of treating low-grade dumps economically when they will not stand the cost of orthodox handling. Although a smaller portion of the gross value contained is recovered, the margin of net profit obtained may be increased substantially by eliminating sorting, crushing, and grinding. The operation was a case of "grab and run," limited by the grade of the ore and the short season imposed by the weather conditions.

It is probable that the reasoning behind the treatment employed at the Dynamite can be applied to other marginal workings of a similar nature to convert an otherwise probable loss into a net operating profit.

Supplementary Data

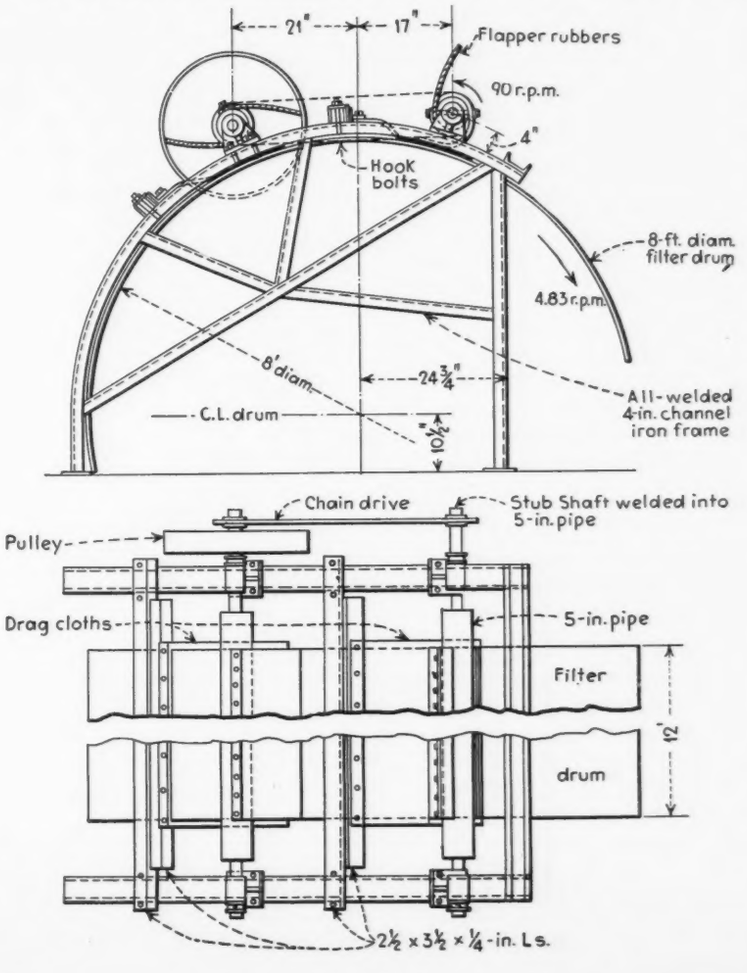
Feed rate, tons per 24 hrs			100
Total feed tonnage (*a*), tons			5,000
Total concentrate tonnage (*a*), tons			535
Average concentrate tonnage (*a*), tons per 24 hrs			10.7
Flotation reagents			
Z_4 (10% solution), lb. per ton			0.127
Pine oil, lb. per ton			0.293
Dump sizes	minus 1 in., %		80
	minus ¼ in., %		55
	minus ⅛ in., %		80
Assays (average) (*b*)	Heads		$5.77 (*b*)0.165 oz.
	Tails		0.87 (*b*)0.025 oz.
(*c*)	Concentrates		27.67 (*b*)0.793 oz.
(*c*) Primary table cut		78.60	2.25
Ratio of concentration		5.5-1	
Extraction		87.7%	

(*a*) These figures were obtained for the run made with the original flowsheet, bypassing the grinding circuit. (*b*) All assays recorded in dollars and cents, combining the gold and silver values. Assays reported in ounces per ton. Principal tailings losses were in silver, with gold often only a trace. (*c*) Difference between table and final concentrate assays is accounted for by the fact that a bulk float was made, bringing over a great deal of barren iron pyrites.

Novel Flapper for Drum Filter

AN INNOVATION at the concentrator of Consolidated Mining & Smelting Company of Canada, Ltd., Chapman Camp, B. C., Canada, is the method of extracting additional moisture from filter cake by means of a simple flapper arrangement, details of which are given in the accompanying drawings. The units employing this device are two 8x12-ft. drum-type continuous filters handling final lead concentrates. As will be seen, each contrivance consists of an all-welded steel frame made from 4-in. channel irons, the two flapper units proper, and two angle-iron cross-pieces holding the drag cloths resting on the drum surface beneath the flapper shafts. These are made from standard 5-in. steel pipe with welded-in 2-in. stub shafts and operate in dolly box bearings clamped to 4-in. channels. The rubber flappers (Gutta Percha, stock No. 659) measure 12 in. by 12 ft. 2 in. by ¼ in., tapering to the tip, and are clamped to the flapper shaft by means of a 1½x⅜-in. steel strip and ⅜-in. bolts spaced at 4-in. centers.

The drag cloths (Dunlop "Record Breaker," stock No. 358) measure 24 in. by 12 ft. 6 in. by ⅛ in., and are held to the 2½x3½-in. L-irons by a steel strip and ⅜-in. bolts at 6-in. centers. The steel frame with the flappers and the drag cloth holders is bolted to the angle iron forming the rim of the filter tank and thus can easily be removed whenever repairs are needed on the filter drum. Speed of the filter drum and flapper shafts is 4.83 and 90 r.p.m. Motive power is furnished by the 2-hp., 1,200 r.p.m., back-gear motor through a belt drive and a chain drive. As a result of the installation of these flapper units the moisture content of the 1⅛-in. filter cake has been reduced from 10.2 to 7.98 per cent.



Boliden Improves Work

At Ronnskar Smelter

New mine in Skelleftea district shipping to plant

▶ DEVELOPMENTS *that have taken place at the Rönnskär smelter of the Boliden Mining Company in Sweden, since the article by A. G. Paul Palen was published in "Engineering and Mining Journal" for June, 1932, include the following, according to Mr. Palen:*

AMONG THE FIRST investigations on the Boliden ore were flotation tests, which aimed specially at separating out barren pyrite, which constitutes an important percentage of the ore minerals. At first no acceptable results could be obtained, wherefore the initial flowsheet as published in the article mentioned was adopted. This, however, left the opportunity open to treat the ore by flotation before the roasting and smelting, thereby decreasing the tonnage to be smelted and improving the metallurgical practice.

To study the concentration problems thoroughly, intensive research work was started, resulting in a flowsheet by which it was possible to separate the arsenopyrite and copper pyrite from the barren pyrite. A pilot plant with a capacity of 50 tons a day was erected at the mine, in which numerous test runs were made with practically full-sized equipment. With the experience from these runs, a flotation plant was designed and built, in connection with the smelter, which started operations in 1934. Capacity has been gradually increased, and, early in 1938 it was working at the rate of about 250,000 tons a year.

The concentrator is treating two classes of ore, pyrite ore and siliceous ore derived from the mineralized wall rock, in the approximate proportion of 63 and 37 per cent respectively of the total milled. The pyrite ore yields a smelting concentrate and a pyrite concentrate with about 51.5 per cent S and practically free from copper and precious metals. The siliceous ore gives a smelting concentrate and waste.

For 1937, out of 400,000 tons of ore, about 235,000 tons was treated in the concentrator, yielding 85,000 tons of pyrite concentrates and 65,000 tons of smelting concentrate. The total amount of Boliden ore and concentrates going to the roasters is therefore now only about 230,000, against 360,000 tons before the concentration started, with a possibility of being still further reduced. The copper content of the charge, which has been exceptionally low, has been increased by the concentration of part of the ore, which gives an improvement in the metallurgy.

Crushing—The ore that goes direct to the smelter is now crushed finer than before. It passes a screen with slots 7x12 mm. against formerly 15x32 mm. This has greatly improved the reverberatory work, specially when running on a mixture of flotation concentrates of crushed ore.

Bedding—When the wet flotation concentrates first were run on to the ore beds, together with the crushed ore, much trouble was experienced by the mixture baking together, making it difficult to empty the bedding bins. A drier for the concentrates has therefore been installed which removes the major part of the moisture before the concentrates pass to the beds.

Roasting — With the decreased amount of material to be treated (about 700 tons daily instead of 1,000 tons) the roaster capacity is now very ample and eight of the large furnaces (7 m. in diameter and having eleven hearths) are at present sufficient. Some of the high arsenic ore with high values in gold is now roasted separately and afterwards added directly to the converters.

Reverberatory Smelting—Owing to the large amount of converter slag produced, difficulty was had in getting clean reverberatory slag, when all of the slag from the converter was poured back hot directly into the furnace. Part of the converter slag is now allowed to cool and is crushed in a special crushing plant and charged back, together with the other solid charge. In this way the slag when it melts comes in better contact with the sulphur of the calcines and a cleaner furnace slag is obtained.

Converting—While treating only crushed ore directly from the mine, it became necessary to work with a very low grade of matte to keep slag losses down. This transferred much of the slag-making work to the converters, so that this department had to be increased and now contains seven converters. With the introduction of the concentration, which removed a large tonnage of iron from the roasting and smelting, conditions have been improved.

In the anode casting, electrolytic refining, and gold and silver refining departments no important changes have taken place.

Arsenic and Selenium—Besides the reverberatory refining furnace for arsenic, the smelter now has a plant for wet refining of the crude material from the roaster Cottrells. In this plant the crude arsenic is first washed with water to remove sulphuric acid and afterward dissolved in hot water and filtered, whereby the insoluble impurities are removed. The hot solution is treated by multiple-step vacuum crystallization, whereby the pure arsenic is recovered as fine crystals. The sludge from the filtering contains some selenium, bismuth, antimony, etc. Selenium is recovered by a special process and the rest is shipped abroad for further treatment, together with the dust precipitated from the converter gases. Selenium is also recovered in the gold and silver refining.

Sulphur—To lessen the danger of smoke damage to the forests it was found desirable to decrease the amount of sulphur in the stack gases. This has partly been accomplished by the concentration work but with a view to still further reducing this sulphur a process has been developed to treat the roaster gases for the recovery of elemental sulphur. It can be described as a catalytic reduction of the SO_2 by a reducing gas. After a second cleaning in wet Cottrells, part of the gas is passed over incandescent coke in a specially constructed gas producer and afterward joined with the rest of the gas, whereafter the mixture is passed through catalyst chambers, where the final reduction to elemental sulphur takes place. The gas containing the sulphur is then cooled and the main part of the sulphur is recovered in a liquid state before the rest of the sulphur is precipitated in a specially designed Cottrell treater. The sulphur plant consists of seven sections, each one with a capacity of 4,000 to 5,000 tons of sulphur per year. The sulphur that is produced is of exceptionally high quality and is sold largely to the sulphite pulp mills operating in northern Sweden.

On some of the other deposits which have been discovered in the Skelleftea field by geophysical prospecting, development work has been done, with the result that one of them, Laver, was to be ready for production in February. The ore is a mixture of copper and iron pyrite with some gold and silver. About 150,000 tons per year will be mined and treated by flotation, giving about 12,000 tons of copper concentrate with about 20 per cent

copper, which will be smelted at Rönnskär.

The mine is situated about 250 km. northeast of Boliden and 50 km. from the railroad in the middle of a forest district. An up-to-date concentrator is erected in connection with the shaft. The concentrates will be transported on trucks to the railroad and from there by rail to Rönnskär. Two other mines also will probably initiate ore production in the near future.

The company's research work on new and extended use of arsenic for various purposes has, among other results, given a new process for preserving wood. Not fewer than nine impregnation plants using this preservative have been installed in different parts of the country. One plant is built in Boliden for the treatment of mine timber.

▼ ▼ ▼

Accurate Triangulation

In Mountainous Country

Vertical Eccentric Reduction in First to Second Order Work

Theodore A. Dodge
Assistant Geologist
Cerro de Pasco Copper Corporation
Morococha, Peru

ACCURATE triangulation on a small scale is necessary in the Morococha district, Peru, where claims of many different ownerships occur, where long-range raise and tunnel connections with the surface are common, and where the ruggedness of the topography makes traversing difficult. In the adjustment of the vertical angles from reciprocal observations in a part of the triangulation net recently established here, it was found that the formula:

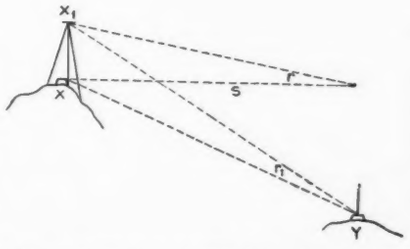
$$(1) \qquad r = -\frac{t - o}{s \sin 1''}$$

used by the Coast and Geodetic Survey[1] is not sufficiently exact in all cases to give results consonant with the accuracy of the horizontal adjustment, which is between first and second order as defined by the United States Board of Surveys and Maps. The reason for this is that the net covers a relatively small area of considerable relief.

Referring to the figure, XY is the line whose zenith distance it is desired to know. X_1Y is what is actually observed. To correct X_1Y to XY it is necessary to subtract the angle r_1. The formula:

$$(1) \qquad r = -\frac{t - o}{s \sin 1''}$$

where t is the height of the telescope above X and o is the height of sight above Y (in this case zero), r being expressed in seconds, gives r as a correction instead of r_1.



In ordinary work this error, $r - r_1$, is compensated by an equivalent error introduced when the instrument is set up at Y, and X is sighted. If, however, the instrument is set up above the station at X and below the station at Y, or if $t - o$ at X is very different from $t - o$ at Y, the errors will not compensate and may add. If this condition is coupled with a small horizontal distance, s, and a steep angle from X to Y, errors of 15 seconds or more may enter.

According to Walter F. Reynolds[2], Chief of the Section of Triangulation of the United States Coast and Geodetic Survey, who has been kind enough to consult with me in this matter, it would be very unusual in their work to have a zenith distance differing by more than 3 deg. from 90 deg. With such a small vertical angle even the most extreme assumptions as to values for s and $t - o$ give a possible error of only a very few seconds. In Morococha, however, the rugged topography leads to small values of s and zenith distances differing from 90 deg. by as much as 15 deg. To keep the vertical work, therefore, of an accuracy consonant with that of the horizontal work, it has been found necessary in certain cases to use the true formula for determining the zenith distance correction. In the belief that conditions similar to those in Morococha may exist in other mining camps, particularly in South America, it is deemed worth while to give the true formulas here.

The full formula may be expressed as follows, using a form slightly different from that of the C.G.S.

$$(2) \qquad \tan r = -\frac{(t - o)\cos^2 V}{s \pm (t - o)\cos V \sin V}$$

where V is the vertical angle, or in other words the difference between 90 deg. and the zenith distance; t and o are negative when they are below their station. The plus sign in the denominator is used for up-shots, the minus sign for down-shots. The second term in the denominator is negligible for all except very extreme cases. Also, ordinarily, the sine may be used instead of the tangent, thus giving a form closely similar to that of the Coast and Geodetic Survey, r being expressed in seconds.

$$(3) \qquad r = -\frac{(t - o)\cos^2 V}{s \sin 1''}$$

This formula is only slightly more complicated than (1) and is convenient for all shots where there is a chance of error in using (1). However, it is possible to place arbitrary limits for the use of the various formulas, which will in practice give errors of up to a very few seconds, no consideration being made of the possibility of compensation or addition of errors. Assuming lengths in any units and angles in degrees, then

if

$$\frac{(t - o)\ V}{s} < 0.01, \text{ use formula (1)}$$

if

$$\frac{(t - o)\ V}{s} > 0.01, \text{ use formula (3)}$$

if

$$\frac{(t - o)\ V}{s} > 0.10, \text{ use formula (2)}$$

[1] Walter F. Reynolds. "Manual of Triangulation Computation and Adjustment." U. S. Coast and Geodetic Survey, Special Publication No. 138, 1934, p. 148. Also "Manual of Second and Third Order Triangulation and Traverse." U. S. Coast and Geodetic Survey, Special Publication No. 145, 1935, p. 106.

[2] Personal communication.

Summary of the

MARKETS

BUSINESS and industrial activity moved upward during August, but the rate of improvement was moderate and not sufficient to influence prices of major metals. Toward the close of the month the political tension in Europe was such as to make buyers act with reserve. Nervousness in the London market unsettled prices there.

Average domestic prices for the month in copper, lead, and zinc were higher than in the preceding month, resulting in a gain in the *E. & M. J.* index from 72.95 for July to 73.94 for August. A year ago the price index stood at 95.28.

Copper statistics for July were favorable, showing a reduction in world stocks of refined metal of 28,299 tons. Another reduction in stocks is expected for August. Actual consumption of copper in the United States has increased to about 46,000 tons a month. Domestic sales for August dropped to 23,195 tons, but, in view of the large purchases in July, the reduced volume of business was more or less expected. The quotation held at 10½c., Valley, throughout the month. The undertone was steady. Prices abroad eased moderately, reflecting uncertainty over the tension on the Continent.

The depressed London market for lead and zinc had a direct bearing on business in those metals in this country. On more than one occasion the London equivalents, plus duty and other charges, came close to domestic parity. Because of this situation, buyers here bought sparingly, even though consumption has been increasing.

Refined platinum was raised to $39 per ounce. Cadmium, which has been inactive for some time because of the reduced rate of operations in the automobile industry, was lowered by producers to 75c. per pound. Quicksilver was easier on moderate selling pressure. Tin consumption remains low, which tends to offset the measures adopted by producers to raise the price.

UNITED STATES MARKET

	Electrolytic Copper		Straits Tin	Lead		Zinc
1938 Aug.	Domestic (a)	Export (b)	New York	New York	St. Louis	St Louis
1	9.900	9.975	43.900	4.90	4.75	4.75
2	9.900	10.025	43.700	4.90	4.75	4.75
3	9.900	10.075	43.650	4.90	4.75	4.75
4	9.900	10.025	43.500	4.90	4.75	4.75
5	9.900	10.025	43.500	4.90	4.75	4.75
6	9.900	10.025	43.750	4.90	4.75	4.75
8	9.900	10.025	43.450	4.90	4.75	4.75
9	9.900	10.025	43.250	4.90	4.75	4.75
10	9.900	10.000	43.300	4.90	4.75	4.75
11	9.900	9.975	43.350	4.90	4.75	4.75
12	9.900	9.750	43.125	4.90	4.75	4.75
13	9.900	9.725	43.125	4.90	4.75	4.75
15	9.900	9.675	43.000	4.90	4.75	4.75
16	9.900	9.650	42.900	4.90	4.75	4.75
17	9.900	9.675	43.175	4.90	4.75	4.75
18	9.900	9.675	43.000	4.90	4.75	4.75
19	9.900	9.700	43.000	4.90	4.75	4.75
20	9.900	9.700	43.000	4.90	4.75	4.75
22	9.900	9.700	42.925	4.90	4.75	4.75
23	9.900	9.675	42.875	4.90	4.75	4.75
24	9.900	9.725	43.600	4.90	4.75	4.75
25	9.900	9.825	43.225	4.90	4.75	4.75
26	9.900	9.900	43.425	4.90	4.75	4.75
27	9.900	9.900	43.425	4.90	4.75	4.75
29	9.900	9.825	42.800	4.90	4.75	4.75
30	9.900	9.775	43.250	4.90	4.75	4.75
31	9.900	9.725	43.250	4.90	4.75	4.75
For month Average	9.900	9.844	43.276	4.90	4.75	4.75
Aug.			**AVERAGES FOR WEEK**			
3	9.879	10.000	43.875	4.90	4.75	4.75
10	9.900	10.021	43.458	4.90	4.75	4.75
17	9.900	9.742	43.113	4.90	4.75	4.75
24	9.900	9.696	43.067	4.90	4.75	4.75
31	9.900	9.825	43.229	4.90	4.75	4.75
Aug.			**CALENDAR WEEK AVERAGES**			
6	9.900	10.025	43.667	4.90	4.75	4.75
13	9.900	9.917	43.267	4.90	4.75	4.75
20	9.900	9.679	43.013	4.90	4.75	4.75
27	9.900	9.788	43.246	4.90	4.75	4.75

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

	Sterling Exchange		Silver		Gold	
1938 Aug.	"Checks"	"90-day demand"	(c) New York	London	London	(d) United States
1	4.915000	4.908125	42.750	Holiday	Holiday	$35.00
2	4.905000	4.898125	42.750	19.5625	141s 8d	35.00
3	4.892500	4.885625	42.750	19.4375	142s ½d	35.00
4	4.894375	4.887500	42.750	19.5000	142s ½d	35.00
5	4.891250	4.884375	42.750	19.3750	142s	35.00
6	4.893125	4.886250	(e)	19.4375	142s 1½d	35.00
8	4.882500	4.875625	42.750	19.3750	142s 3d	35.00
9	4.877500	4.870625	42.750	19.5000	142s 7½d	35.00
10	4.881250	4.874375	42.750	19.5625	142s 6d	35.00
11	4.878750	4.871875	42.750	19.4375	142s 4½d	35.00
12	4.872500	4.865625	42.750	19.5000	142s 8d	35.00
13	4.871875	4.865625	(e)	19.5625	142s 9d	35.00
15	4.870625	4.863750	42.750	19.4375	142s 8d	35.00
16	4.876875	4.870625	42.750	19.5000	142s 8½d	35.00
17	4.880625	4.874375	42.750	19.4375	142s 4½d	35.00
18	4.878750	4.871875	42.750	19.3750	142s 5½d	35.00
19	4.876250	4.869375	42.750	19.3750	142s 6½d	35.00
20	4.880000	4.873125	(e)	19.3125	142s 5½d	35.00
22	4.880000	4.873125	42.750	19.3125	142s 5d	35.00
23	4.878125	4.870625	42.750	19.3125	142s 6½d	35.00
24	4.881250	4.874375	42.750	19.1250	142s 6d	35.00
25	4.881250	4.874375	42.750	19.2500	142s 5½d	35.00
26	4.877500	4.870000	42.750	19.3125	142s 7d	35.00
27	4.871875	4.864375	(e)	19.3125	142s 8d	35.00
29	4.870000	4.862500	42.750	19.1875	142s 8½d	35.00
30	4.858750	4.851250	42.750	19.3750	142s 11d	35.00
31	4.854375	4.846875	42.750	19.2500	143s 3½d	35.00
Average for Mo.	4.88044	.....	42.750	19.389	.....	35.00
Aug.			**AVERAGES FOR WEEK**			
3	4.91021	.....	42.750	.....	.....	.....
10	4.88667	.....	42.750	.....	.....	.....
17	4.87521	.....	42.750	.....	.....	.....
24	4.87906	.....	42.750	.....	.....	.....
31	4.86896	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver, Aug. 6th, 42.750; 13th, 42.750; 20th, 42.750; 27th, 42.750.

(e) Not quoted; Saturday.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1938, the U. S. Government's price on newly mined domestic silver was established at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛c. per ounce throughout August.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quotated by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1938 Aug.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1.....						Holiday							
2.....	41.1875	41.4375	47.0000	194.0000	195.2500	14.5625	14.6250	14.6875	14.7500	13.8125	13.8750	14.0625	14.1250
3.....	41.6875	41.9375	47.0000	195.2500	196.2500	14.6250	14.6875	14.8125	14.8750	13.8750	13.9375	14.1250	14.1875
4.....	41.3125	41.6250	47.0000	193.7500	194.7500	14.4375	14.5000	14.5625	14.6250	13.8125	13.8750	14.0625	14.1250
5.....	41.3125	41.6250	46.5000	193.7500	195.0000	14.3750	14.4375	14.5625	14.6250	13.8125	13.8750	14.0625	14.1250
8.....	41.6250	41.9375	46.7500	194.7500	195.7500	14.4375	14.5000	14.6250	14.6875	13.9375	14.0625	14.1875	14.3125
9.....	41.4375	41.7500	46.7500	194.0000	195.2500	14.3125	14.4375	14.5625	14.6250	13.9375	14.0000	14.1875	14.2500
10.....	41.1875	41.5000	46.5000	194.0000	195.2500	14.3125	14.4375	14.5000	14.5625	13.8125	13.8750	14.0000	14.1250
11.....	41.1250	41.4375	46.7500	194.0000	195.0000	14.2500	14.3750	14.5000	14.5625	13.8125	13.8750	14.0625	14.1250
12.....	40.4375	40.7500	45.2500	193.7500	194.7500	14.1250	14.1875	14.2500	14.3125	13.5625	13.6875	13.8125	13.8750
15.....	40.1875	40.5000	45.5000	192.5000	193.7500	14.2500	14.3125	14.3125	14.3750	13.4375	13.5625	13.6875	13.7500
16.....	39.6875	39.9375	45.0000	191.7500	192.7500	13.9375	14.0625	14.0625	14.1250	13.1250	13.2500	13.3125	13.3750
17.....	39.8125	40.0625	45.5000	192.7500	193.7500	13.9375	14.0625	14.0625	14.1250	13.1250	13.2500	13.3125	13.3750
18.....	39.6250	39.9375	45.0000	192.7500	193.7500	14.0625	14.1250	14.1250	14.1875	12.8750	12.9375	13.1250	13.1875
19.....	40.0000	40.2500	45.0000	192.2500	193.2500	14.3125	14.3750	14.3750	14.4375	12.9375	13.0625	13.1875	13.2500
22.....	40.1875	40.4375	45.2500	191.5000	192.0000	14.5625	14.6875	14.6250	14.6875	13.2500	13.3750	13.4375	13.5000
23.....	40.0000	40.2500	45.0000	190.5000	191.2500	14.4375	14.5000	14.5000	14.5625	13.0000	13.1250	13.2500	13.3125
24.....	40.3750	40.6250	45.7500	192.5000	193.5000	14.3750	14.5000	14.5000	14.5625	13.0625	13.1250	13.2500	13.3125
25.....	40.6250	40.8750	46.0000	193.2500	194.2500	14.5625	14.6875	14.6875	14.7500	13.1875	13.3125	13.4375	13.5000
26.....	40.8125	41.0625	46.0000	193.0000	194.0000	14.5625	14.6875	14.6875	14.7500	13.1250	13.2500	13.3750	13.4375
29.....	40.0000	40.2500	45.5000	190.5000	191.5000	14.3125	14.3750	14.3750	14.4375	13.1250	13.2500	13.3125	13.3750
30.....	40.0625	40.3750	45.5000	192.0000	193.0000	14.1250	14.2500	14.1875	14.2500	13.1250	13.2500	13.3125	13.3750
31.....	40.3125	40.5000	45.5000	192.7500	193.7500	14.2500	14.3750	14.3125	14.3750	13.4375	13.5625	13.5000	13.6250
Average for month..	40.591	.....	45.909	192.966	.....	14.371		14.480		13.467		13.675	

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated
(Sept. 1, 1938)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb ..... 20c.
Antimony, domestic, spot, lb ..... 11.25c.
Bismuth, ton lots, lb $1.05
Cadmium, lb ..... 75c. @$1.05
Calcium, lb., ton lots 98 @ 99 per cent ..... 75c.
Chromium, 97 per cent grade, lb ..... 85c.
Nickel, electrolytic cathodes, lb ..... 35c.
Magnesium, 99.8 per cent, carloads, lb ..... 30c.
Palladium, troy oz $24.00
Platinum, (Official quotation) troy oz $39.00
Quicksilver, flask of 76 lb., 100 flasks or more ..... $74.50@$75.50
Radium, mg. radium content $40.00
Selenium, 99.5 per cent, lb $2.00
Silicon, minimum 97 per cent, spot, lb 16.50c
Tellurium, lb ..... $1.75@$2.00
Thallium, 100 lb. or more, lb $6.50
Titanium, 96 to 98 per cent, lb $6.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton ..... $30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton ..... $22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:
Old Range bessemer $5.25
Mesabi bessemer $5.10
Old Range non-bessemer $5.10
Mesabi, non-bessemer $4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton $55.10
Manganese Ore, c.i.f. Atlantic ports, long ton unit:
52 @ 55 per cent ..... 35c.
50 @ 52 per cent ..... 35c.
44 @ 48 per cent ..... 30c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2 ..... 45c.
Tungsten Ore, per unit of WO_3:
Chinese, 65 per cent, duty paid $20.50
Domestic, 70 per cent and upward ..... (a)$20.00
Vanadium Ore, per lb. of contained V_2O_5 ..... 27½c.
Zinc, Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton $30.50
(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb 3c
Cobalt Oxide, 70 @ 71 per cent, lb ..... $1.67@$1.77
Copper Sulphate, 100 lb $4.25
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb $1.42
Sodium Sulphate, bulk, ton ..... $13.00@$15.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be $23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb ..... 10½c.
Ferromanganese, 78 @ 82 per cent, gross ton $92.50
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo contained. 95c
Ferrosilicon, 50 per cent, gross ton $69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained $1.65

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:
Canadian (Quebec)
Crude No. 1 ..... $700@$750
Crude No. 2 ..... $150@$350
Spinning fibers ..... $110@$200
Paper stock ..... $40@$45
Shorts ..... $12@$16.50
Vermont
Shingle stock $57
Paper stock $40
Cement stock $25
Barytes, long ton:
Georgia, crude $7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron ..... $6.00@$7.00
Bauxite, long ton:
Domestic, chemical, 55 @ 58 per cent ..... $6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent ..... $12.50@$15.00
Dalmatian, 50 @ 55 per cent ..... (a)$6.50@$7.50
French, 56 @ 59 per cent ..... (a)$7.50@$8.50
China Clay, f.o.b. mines, ton:
South Carolina and Georgia, No. 1, bulk ..... $6.75@$8.00
Delaware, No. 1 ..... $14.50
Feldspar, bulk, ton:
Potash feldspar, 200 mesh $17.00
Glass-spar, white, 20 mesh $11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton $18.00
Fuller's earth, f.o.b. Georgia or Florida, ton ..... $7.00@$14.00
Magnesite, per ton:
Dead-burned, f.o.b. California $22.00
Dead-burned, f.o.b. Washington $22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:
1½ x 2 in ..... 15@40c.
2 x 2 in ..... 30@60c.
3 x 3 in ..... 75@$1.20
3 x 4 in ..... $1.00@$1.40
4 x 6 in ..... $2.00@$2.50
White, ground, 70 mesh, ton ..... $60.00@$80.00
Ocher, Georgia, ton ..... $19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports ..... (a) 12@12½c.
Silica, in bags, 325 mesh, ton ..... $18.00@$40.00
Sulphur, Texas mines, long ton $18.00
Talc, f.o.b. works, ton:
New York, double air-floated, 325 mesh ..... $12.00@$15.00
New Jersey, mineral pulp ..... $8.00@$10.00
Vermont, extra white, 200 mesh ..... $9.00@ $9.50
Tripoli, Missouri, ton:
40 mesh, cream colored $14.50
200 mesh, cream colored $26.00
(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:
Bessemer $20.50
Basic $19.50
No. 2 Foundry $20.00
Steel, base prices, Pittsburgh:
Billets, gross ton $34.00
Structural shapes, 100 lb $2.10
Bars, 100 lb $2.25

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1937	1938	1937	1938	1937	1938
January	44.913	44.750	20.734	19.895	490.670	499.895
February	44.750	44.750	20.083	20.159	489.307	501.722
March	45.130	44.446	20.677	20.088	488.412	498.394
April	45.460	42.750	20.740	18.880	491.524	498.046
May	45.025	42.750	20.346	18.731	493.835	496.673
June	44.818	42.750	20.022	18.945	493.404	495.772
July	44.750	42.750	19.986	19.356	496.582	492.855
August	44.750	42.750	19.848	19.389	498.043	488.044
September	44.750	.....	19.889	.....	495.145	.....
October	44.750	.....	19.942	.....	495.395	.....
November	44.750	.....	19.707	.....	499.467	.....
December	44.750	.....	18.835	.....	499.510	.....
Year	44.883	.....	20.067	.....	494.275	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot (a)			
	Domestic		Export		Standard		Electrolytic	
	1937	1938	1937	1938	1937	1938	1937	1938
January	12.415	10.198	12.112	9.908	51.497	41.387	56.288	45.387
February	13.427	9.775	13.828	9.525	59.225	39.597	64.013	43.563
March	15.775	9.775	16.590	9.496	72.339	39.772	76.167	43.582
April	15.121	9.775	14.692	9.443	62.506	39.306	66.614	43.408
May	13 775	9.375	13.999	8.801	61.118	36.668	63.684	40.852
June	13.775	8.775	13.492	8.500	55.696	35.235	61.409	39.417
July	13.775	9.585	13.817	9.573	56.412	39.744	62.807	44.405
August	13.775	9.900	13.926	9.844	57.143	40.591	63.595	45.909
September	13.530	.....	12.984	.....	52.989	.....	58.966	.....
October	11.838	.....	11.207	.....	45.384	.....	50.619	.....
November	10.797	.....	9.850	.....	39.321	.....	44.023	.....
December	10.006	.....	9.714	.....	39.946	.....	43.886	.....
Year	13.167	.....	13.018	.....	54.465	.....	59.339	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1937	1938	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	6.000	4.870	5.850	4.720	27.272	27.150	16.135	16.253
February	6.239	4.632	6.089	4.482	28.319	28.328	15.402	15.525
March	7.190	4.500	7.040	4.350	33.027	32.979	15.992	16.075
April	6.175	4.500	6.025	4.350	26.014	25.878	15.579	15.623
May	6.000	4.400	5.850	4.250	24.000	23.891	14.210	14.376
June	6.000	4.148	5.850	3.998	22.878	22.759	13.969	14.012
July	6.000	4.882	5.850	4.732	23.932	23.703	14.921	15.034
August	6.452	4.900	6.302	4.750	22.606	22.670	14.371	14.480
September	6.400	.....	6.250	.....	20.990	21.044	.....	.....
October	5.740	.....	5.590	.....	18.259	18.318	.....	.....
November	5.033	.....	4.883	.....	16.706	16.714	.....	.....
December	4.875	.....	4.725	.....	15.905	15.994	.....	.....
Year	6.009	.....	5.859	.....	23.326	23.286	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1937	1938	1937	1938
January	50.925	41.548	229.350	183.619
February	52.010	41.373	233.750	183.144
March	63.043	41.219	282.988	183.473
April	59.172	38.430	267.136	168.612
May	55.651	36.885	250.645	162 693
June	55 851	40.376	249.852	177.429
July	59.245	43.428	263.540	192.542
August	59.465	43.276	264.595	192.966
September	58.675	.....	258.943	.....
October	51.654	.....	223.869	.....
November	43.299	.....	190.477	.....
December	43.051	.....	190.449	.....
Year	54.337	.....	242.133	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1937	1938	1937 Spot	1937 3 Mos.	1938 Spot	1938 3 Mos.
January	5.847	5.000	21.153	21.281	14.994	15.173
February	6.465	4.813	25.122	25.322	14.408	14.589
March	7.381	4.417	33.188	33.405	14.364	14.477
April	7.010	4.141	26.216	26.344	13.729	13.919
May	6.750	4.042	23.092	23.365	12.682	12.869
June	6.750	4.131	21.409	21.528	12.890	13.104
July	6.923	4.745	22.568	22.693	14.144	14.371
August	7.192	4.750	24.140	24.290	13.467	13.675
September	7.190	.....	21.406	21.607	.....	.....
October	6.085	.....	17.722	17.955	.....	.....
November	5.630	.....	15.808	15.970	.....	.....
December	5.010	.....	15.274	15.429	.....	.....
Year	6.519	.....	22.258	22.432	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1937	1938	1937	1938
January	90.000	117.500	19.500	20.000
February	90.000	117.500	19.500	20.000
March	101.667	117.500	20.000	20.000
April	105.000	102.500	20.000	20.000
May	105.000	102.500	20.000	20.000
June	130.962	102.500	20.000	20.000
July	142.500	102.500	20.000	20.000
August	142.500	99.722	20.000	20.000
September	142.500	.....	20.000	.....
October	142.500	.....	20.000	.....
November	142.500	.....	20.000	.....
December	132.888	.....	20.000	.....
Year	122.335	.....	19.917	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium cents per pound, average of producer's and plater's quotations.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1937	1938	1937	1938	1937	1938
January	14.130	13.750	90.250	79.240	50.400	36.000
February	14.563	13.750	91.000	76.455	64.364	36.000
March	16.375	13.750	91.778	72.444	58.000	36.000
April	16.043	13.654	92.000	71.019	58.000	36.000
May	14.830	12.460	95.520	74.640	54.800	33.400
June	14.702	11.731	96.654	80.731	53.000	33.231
July	14.803	11.030	93.904	76.860	50.115	36.000
August	15.327	10.880	91.423	75.500	51.000	37.000
September	16.555	.....	89.020	.....	51.000	.....
October	16.935	.....	86.140	.....	48.560	.....
November	15.848	.....	83.435	.....	43.652	.....
December	14.144	.....	81.038	.....	38.385	.....
Year	15.355	.....	90.180	.....	51.773	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1937	1938	1937	1938	1937	1938
January	21.50	24.50	20.50	23.50	21.00	24.00
February	21.50	24.50	20.50	23.50	21.00	24.00
March	24.20	24.50	23.20	23.50	23.70	24.00
April	24.50	24.50	23.50	23.50	24.00	24.00
May	24.50	24 50	23.50	23 50	24.00	24.00
June	24.50	23.73	23.50	22.73	24.00	23.23
July	24.50	20.50	23.50	19.50	24.00	20.00
August	24.50	20.50	23.50	19.50	24.00	20.00
September	24.50	.....	23.50	.....	24.00	.....
October	24.50	.....	23.50	.....	24.00	.....
November	24.50	.....	23.50	.....	24.00	.....
December	24.50	.....	23.50	.....	24.00	.....
Year	23.975	.....	22.975	.....	23.475	.....

Iron in dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

H. I. Altschuler is now doing consultation work and can be reached at Room 2170, 630 Fifth Ave., New York City.

Mark L. Summers recently left Utah and is now with the Gold Hill Dredging Company, of Loomis and Oroville, Calif.

G. G. Campbell, mine manager of Wendigo Gold Mines, Kenora, Ont., has accepted a similar position with Jacola Mines, Ltd., at Val d'Or, Que.

A. L. Almy, formerly with Empresa Minera Huanuni, Huanuni, Bolivia, has returned to the United States and is now mill superintendent for Keystone Mines, Inc., at Kingman, Ariz.

H. E. Doelle, manager of Sheep Creek Gold Mines, Salmo, B. C., has become manager, also, of Gold Belt Mining Company, of Salmo, by mutual agreement of the two companies.

N. H. Atkinson has returned to Canada from Bolivia, where he was superintendent of Cia. Minera Unificada del Cerro de Potosi, and is at the Hallnor mine, Pamour, Ont.

L. H. Chapman, mining engineer, has left the Philippine Islands to join the mining staff of Big Bell Mines, Ltd., at Cue, Western Australia.

E. J. Horwood, superintendent of mines for the Broken Hill Proprietary Company, Ltd., recently completed 50 years' service with that company.

Norman L. Wimmler, consulting mining engineer, recently returned to his office at 74 New Montgomery St., San Francisco, following examination of mining properties in Colombia, South America, for an Eastern syndicate.

John W. H. Piper, consulting mining engineer, has returned to London following a mine examination in Colombia, South America.

V. V. Kelsey has resigned from Consolidated Feldspar Corporation, Trenton, N. J., effective Sept. 1, to accept the presidency of Dominion Minerals, Inc., Washington, D. C.

Roy B. Earling, of Fairbanks, Alaska, has been advanced to the position of vice-president and general manager in charge of the operations of the United States Smelting, Refining & Mining Company in the Fairbanks area. He has been associated with the company at Fairbanks since 1927.

Ray M. Henricksen, consulting mining engineer, has resigned his position as associate professor of mining at the University of Alaska, and may be addressed at 901-2 Pacific Mutual Building, Los Angeles, Calif. He recently completed mine examinations work in the Willow Creek district of Alaska.

Will H. Coghill, of Roseville, Ill., has been appointed supervising engineer of the Southern Experiment Station of the United States Bureau of Mines, at Tuscaloosa, Ala. He is also promoted to the post of principal engineer of the nonmetals division of the Bureau. Following fourteen years of practical experience as a mining engineer, Mr. Coghill entered

WILL H. COGHILL

the service of the Bureau as a metallurgist in 1917. He has been with the Bureau ever since. He is the author of numerous publications of the Bureau and in the scientific press relating to the cyanide and flotation processes and the concentration and grinding of ores.

Louis Slessinger, mill shift boss with the Cuban Mining Company, Cristo, Cuba, has returned to his duties after a month's vacation in the United States visiting with relatives and friends in St. Louis, Mo., and Indianapolis, Ind.

R. J. Morgan has been appointed mining engineer to Kentan Gold Areas, Ltd., which is conducting mining and milling operations in Tanganyika Territory and Kenya Colony, in Africa. Mr. Morgan has had 35 years' practical experience in mining in many parts of the world.

George T. Anderson, formerly chief of the engineering department for Nurupi Kozan Kabushiki Kaisha, Taiyudo, Korea, has been employed since May last as metallurgical control engineer for Johns-Manville Products Corporation at Lompoc, Calif. On his return to the United States, Mr. Anderson was married to the former Miss Viola Janith Adams, of Oakland, Calif.

R. H. Hunt has assumed charge of the United States Smelting, Refining & Mining Company's Western exploration department, with offices in the Newhouse Building, Salt Lake City. Mr. Hunt some years ago was chief geologist at the Salt Lake office of the company and was also employed in a consulting capacity.

Quirico Abadilla, director of the Philippine Bureau of Mines, left Manila in July for a six weeks' trip to Java and Sumatra. He will study the relationship between the Dutch Government and the Asiatic Petroleum Company, which is developing on a big scale the oil fields of Sumatra. One of the objects of his trip will be to look into exploration and development methods with the view of introducing them into the Philippines in connection with the plan of the government to work the oil fields of the Islands.

Dr. Peter Trotzig, Freiberg, Germany, has been appointed general manager of five state-owned mining companies operating in Saxony, with headquarters in Freiberg. He will also serve as consulting engineer to the Sachsenerz Bergwerksgesellschaft m.b.H., which operates the remaining state-owned mines in Saxony.

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OBITUARY

Leslie G. Carlton, a mining man with extensive interests in Western industry, died in Colorado Springs on Sept. 4.

William P. Simpson, assayer and chemist, Denver, Colo., died Aug. 14 after a brief illness following a heart attack. He was 63.

Raymond O. Morrow, manager of Briarcliff Mines, Ltd., at Plymouth, Calif., died on July 25. He was 50 years old.

Charles William Baker, who retired in 1928 as president and chairman of the board of American Zinc, Lead & Smelting Company, died recently in New York at the age of 75.

Thomas H. B. Jacobs, a mining engineer formerly active in his profession in the United States and Mexico, died at Glenloch, Pa., on July 29 at the age of 74.

J. E. Hedrick, a mining engineer with extensive properties near Kingman and elsewhere in Arizona, died in Los Angeles on July 24 at the age of 54.

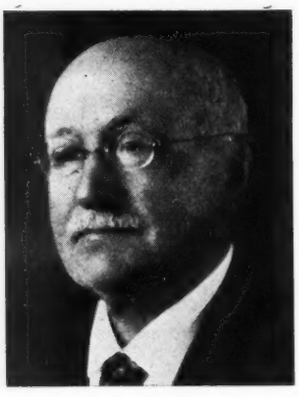
Thomas H. Woods, mill superintendent of Camp Bird mine, near Ouray, Colo., died on July 29 at Ouray at the age of 63. Mr. Wood had been with the Camp Bird company for 41 years.

Cyrus Edward Minor, 56, general superintendent of the Tennessee Copper Company, died on May 5 last at Copperhill, Tenn. Mr. Minor was a graduate of the Missouri School of Mines and for many years engaged in mining in Mexico and Arizona, going to Tennessee in 1923. He was a member of the A.I.M.E.

Henry Samuel Denny, a mining engineer and geologist whose work had taken him to all parts of the world, and who was president of Sudbury Contact Mines, Ltd., and of Mentor Exportation & Development Company and director and consultant for other Canadian mining enterprises, was killed on Aug. 11 at Toronto when he

swerved his car to avoid hitting a child playing in the road. Mr. Denny was 68.

Adolph Lewisohn died on Aug. 17 at his summer home at Saranac Lake, New York. He was 89 years old. Born in Hamburg, Germany, he came to the United States when eighteen to join his brother, Leonard Lewisohn, in the metals business, and the two formed the firm of Lewisohn Brothers. Fate picked Butte, Mont., as the scene of Lewisohn's entry, in 1870, into the business of mining copper, when the newly organized firm took over the property of the Montana Copper Company. Followed the organization of the Boston & Montana Consolidated Copper Company, and the Lewisohns contracted to refine and sell its copper. Upon the organization of the Amalgamated, the refining and selling enterprise was converted into the United



ADOLPH LEWISOHN

Metals Company, of which Adolph Lewisohn was president for a number of years. A genius for success characterized the Lewisohn operations. After his brother's death Adolph Lewisohn became head of the business under the title Adolph Lewisohn & Sons. He organized and was president of Miami Copper, Tennessee Copper & Chemical, South American Gold & Platinum, and General Development. Mr. Lewisohn has been called "New York's most useful citizen." He was philanthropic and civic-minded to a marked degree, but much of his philanthrophy was hidden from the public. The building housing the Columbia School of Mines was a Lewisohn gift. The wealth that flowed from mining and smelting was devoted in important measure to the community, to institutions of higher learning, to providing good music for the masses, shelters for children, prison reform, and to social betterment in many fields. At Lewisohn Stadium, in upper Manhattan, he and Mrs. Lewisohn financed symphony concerts for 21 years. He was a benefactor of Harvard, Yale, Princeton, and Dartmouth—and, alike, of the Young Men's Hebrew Association and the Young Men's Christian Association. He was, as he said, "on both sides." He leaves an honored heritage. An appreciation of Mr. Lewisohn's career and achievements was presented in *Engineering and Mining Journal* of Oct. 9, 1920.

A LETTER

Dust Count Data With Dry Drilling and Ventilation

The Editor:

THE article, "Some Dust Count Data Derived With Wet Drilling and Ventilation," by Messrs. Flinn and Miller, that appeared in the July issue of *Engineering and Mining Journal*, suggests the thought that certain contractors do not want to accept the rules and regulations of the State Department of Labor in regard to preventive measures of dust control.

The law passed in 1935, wherein all industrial diseases became compensable, needs no review here. The chaos created by this act brought about the compromise law in 1936, known as "Labor Law # 222-A." A brief study of this law will readily show that the men were interested in the protection of their health only and not in compensation for incapacity.

Manufacturers of dry drill dust control apparatus have always cooperated with contractors and drill manufacturers in assisting them to solve the problem of protection as demanded by this new legislation. Never have they made any statements or published any data that were detrimental to the wet drill or any other means of dust control. The article mentioned, however, offers material derogatory to dry drill dust control, and should not have been allowed a place in a magazine where technical discussions should give full factual data by each proponent of any controversial subject.

To be specific and refute some of the data in this article, please note that the authors have deducted the sample of the "ambulant" air from that of their dust count to obtain a net count for their method of wet drill control. In no case, where the exhaust method was used, was any deduction made. On one subway job, where no dry blower type drills were used, a dust count was made on the exhaust system on Oct. 13, 1937. We were advised at the time by a representative of the contractor that the count was made on a wet drill, operating dry, with a conveying hose a considerable distance from the hole. This was later verified by the drill operator. On this same contract an official test was made by the State Department of Labor on Nov. 17, 1937. Members of the contractors' group were present, as were the Bureau of Mines men, but none of these data have been published. On another subway job, approved exhaust methods were used for about two weeks, during which time we tried unsuccessfully to get some cooperation; and for the particular test described as "L" pit, etc., the drills were the JA 55, wet type, operating as dry drills. Before delivering this unit to the contractor, the distinct understanding and agreement was had that a dry blower type drill must be used with the exhaust system. For some reason the contractor backed out of this part of the agreement and no blower type drills were brought on the job until Nov. 9, at which time Mr. Tillson proposed to run a test back of the field office at 53d St. This ground consisted of about one foot of soupy mud and eighteen inches of disintegrated hard-pan overlaying disintegrated mica schist. The rate of penetration for the first two feet was four feet per minute and not two inches per minute. When the bit came in contact with the rock, the hole in the steel was thoroughly plugged, causing the fourteen stuck steels; and the balance of the 41 steels would no doubt have been stuck also, had not the drill operators been ordered by their representatives to drill the round properly. A very thorough daily report of the foregoing was kept and a duplicate copy of this was properly filed before any articles on dust control were written by the subway group.

On the Queens Mid-Town tunnel, where the authors admit good dust counts for the exhaust system, motion pictures were taken, with no artificial illumination, from the top of the shaft, with the exhaust system in operation in wet ground. In the case of the wet drill, the men were not visible from the top of the shaft, yet according to this article the dust counts were equally as good as those of the exhaust system. With reference to the tunnel heading where exhaust methods were used, the following was agreed upon, "That after the exhaust system is set up and ready for the test, we be given sufficient time to make our own preliminary tests and get your operators familiar with the use of our equipment before any time-study or other tests are made." These conditions were not adhered to, as dust counts were made immediately upon the starting of the equipment for the first time with dry drills, and in some cases the dust hoods had not been connected. These tests were not conducted by the contractor, but we wish to thank the contractor for the wholehearted cooperation he gave us.

We thank the authors for their generosity in admitting that dust collectors have been adopted in some isolated cases and that some day an apparatus will be designed that will eliminate all of the faults they have been able to conjure. We believe that improvements will follow, but it must be with a spirit of cooperation rather than destructive methods and criticism from certain of the contracting industry, that benefits will be derived by all those concerned in the effort to solve the dust problem.

A suggestion to end the conflicting opinions created by this article, would be to publish a report of the findings of the New York State Department of Labor on their various surveys. Here would be impeccable data that would be fair to all.

THE KADCO CORPORATION
George S. Kelley, Vice-President
THE SPENCER TURBINE COMPANY
R. A. Brackett, Sales Manager
New York, N. Y.

What Metal Statistics Show

BASE METAL PRODUCERS have been encouraged by the improved statistical position of metals that has developed during the last two months. Since signs of industrial activity continue to point upward, the outlook for greater consumption of copper, lead, and zinc during the remainder of the year is considered good. Some in the industry expect more mines to reopen in the near future, and the employment situation has prospects of substantial improvement with the approach of winter. Production schedules, however, are expected to remain on a curtailed basis. Recent tension over the Central European political situation has created a cautious sentiment in this country which, if removed or moderated, will accelerate industrial activity here. Domestic stocks of refined copper declined 9,838 tons in June, 19,001 tons in July, and another decrease is expected for August. Shipments to consumers have increased and actual consumption of copper is now estimated around 46,000 tons per month, against 39,000 tons in July. Lead stocks started to decline in June and the reduction in July was 9,115 tons, and a drop around 8,000 tons is anticipated for August. Stocks of common grades of zinc declined 3,463 tons in July and 2,831 tons in August.

Following is a summary of the figures of the Copper Institute for June and July, in short tons:

	June	July
Production (blister):		
U. S. mine	31,957	25,462
U. S. scrap, etc.	6,243	5,842
Foreign mine	93,192	86,143
Foreign scrap, etc.	12,985	10,329
Totals	144,377	127,776
Production, refined:		
U. S. duty-free	32,465	35,596
Foreign	110,067	103,887
Totals	142,532	139,483
Deliveries to customers, refined:		
U. S. domestic	32,863	41,249
U. S. export	10,440	13,348
Foreign	102,090	113,185
Totals	145,393	167,782
Stock at end, refined:		
United States	358,971	339,970
Foreign	192,524	183,226
Totals	551,495	523,196

▶ZINC—The July and August statistics of the American Zinc Institute, covering all grades, are summarized as follows in short tons:

	July	August
Production	30,362	33,676
Production, daily rate	979	1,086
Shipments	33,825	36,507
Stock at end	146,208	143,377
Unfilled orders	39,350	30,554

Statistics of the Prime Western division, common grades only, for July and August, follow:

	July	August
Stock at beginning	66,675	63,855
Production	13,869	15,342
Shipments	16,689	20,288
Stock at end	63,855	58,909

Zinc production of the world during the first seven months of 1938 amounted to 1,000,727 short tons, against 1,060,850 tons in the same period last year, the American Bureau of Metal Statistics reports. World output for July was 136,430 tons; against 131,885 tons in June and 156,816 tons in July last year.

▶LEAD—The American Bureau of Metal Statistics' figures on refined lead for June and July, in short tons, follow:

	June	July
Stock at beginning	163,723	163,346
Production:		
Domestic ore	33,992	27,976
Secondary and foreign	1,036	3,512
Totals	35,028	31,488
Domestic shipments	35,343	40,601
Stock at end	163,346	154,231

The following tabulation shows total lead stocks at the works of smelters and refiners in the United States so far as reported, in short tons:

	July 1	Aug. 1
In ore, matte, process (a)	45,824	45,990
In base bullion:		
Smelters and refineries	12,038	12,640
In transit to refineries	1,855	1,395
In process at refineries	13,707	14,937
Refined lead	151,781	143,153
Antimonial lead	11,565	11,078
Total stocks	236,770	229,193

(a) At smelters.

Production of refined lead for the world during the first half of 1938 totaled 919,256 short tons, according to the American Bureau of Metal Statistics. This compares with about 910,000 tons in the same period last year. Output of lead in the first half of the current year, by months, for this country and the rest of the world, in short tons, was as follows:

	United States	Elsewhere
January	37,651	123,385
February	33,555	113,396
March	35,129	116,497
April	37,997	109,206
May	31,918	127,554
June	33,992	118,976
Totals	(a) 210,242	709,014

(a) Domestic ore only.

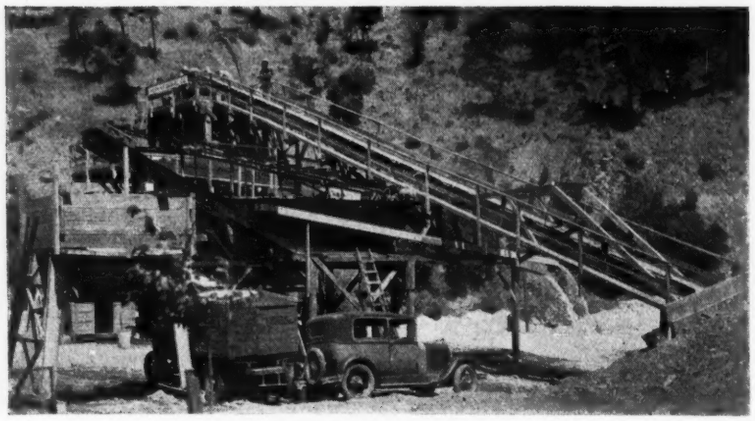
Foreign and Domestic Copper Statistics

Following is a summary of the copper statistics reported by members of the Copper Institute, in short tons:

U. S. Duty Free Cooper		Production Crude (a)	Production Refined	Deliveries to Customers Domestic	Deliveries to Customers Export	Deliveries to Customers Total	Refined Stocks (b)
June 30	1933	.....	.....	.....	.....	.....	600,340
Dec. 31	1933	.....	.....	.....	.....	.....	523,435
Year	1934	360,534	336,710	379,843	125,866	505,709	354,436
"	1935	506,085	496,658	528,194	91,485	619,679	231,415
"	1936	731,629	748,660	764,560	54,447	819,007	161,068
"	1937	982,045	964,176	803,095	62,798	865,893	259,351
6 Mos.	1938	303,371	326,511	178,297	48,596	226,891	358,971
January	1938	58,760	70,487	24,881	5,824	30,705	299,133
February	1938	50,704	59,393	27,389	4,893	32,282	326,244
March	1938	56,199	61,117	33,434	11,142	44,576	342,785
April	1938	50,941	55,749	31,684	11,187	42,871	355,663
May	1938	49,125	47,300	28,044	5,110	33,154	369,809
June	1938	(c) 38,200	32,465	32,863	10,440	43,303	358,971
July	1938	31,304	35,596	41,249	13,348	54,597	339,970
Foreign Copper							
June 30	1933	.....	.....	.....	.....	.....	166,377
Dec. 31	1933	.....	.....	.....	.....	.....	175,604
Year	1934	941,247	884,154	.....	.....	827,063	232,695
"	1935	1,023,481	1,004,473	.....	.....	983,255	253,913
"	1936	966,153	911,887	.....	.....	973,545	192,255
"	1937	1,349,138	1,301,873	.....	.....	1,282,284	211,844
6 Mos.	1938	634,138	633,426	.....	.....	652,746	192,524
January	1938	108,621	103,815	.....	.....	108,823	206,836
February	1938	102,092	101,957	.....	.....	105,903	202,890
March	1938	105,643	108,704	.....	.....	114,127	197,467
April	1938	104,413	106,839	.....	.....	118,390	185,916
May	1938	107,199	102,044	.....	.....	103,413	184,547
June	1938	(c) 106,177	110,067	.....	.....	102,090	192,524
July	1938	96,472	103,887	.....	.....	113,185	183,226

(a) Mine or smelter production and custom intake including scrap (excludes Russia, Japan, Australia, and some miscellaneous production). (b) Stocks end of period at refineries, on consignment and in Commodity Exchange warehouses, but not including consumers' stocks at their plants or warehouses. (c) Corrected.

Note: Deliveries of "foreign copper" do not include domestic copper shipped abroad. The sum of foreign copper deliveries and exports of duty-free copper is the total quantity delivered abroad by members of the Copper Institute.



A contractor who supplies gravel used in concreting the debris dam on the North Fork River, California, employs the equipment shown above to recover gold as a byproduct

CALIFORNIA

Operations Resumed at Argonaut Mine

Underground fire in February forced suspension of operations—One of the world's largest gold dredges being constructed for use in the Hammonton area

▶ The Argonaut mine, at Jackson, Amador County, is producing again after a shutdown since February, when an underground fire on the 4,350 level in the ventilation system of the Muldoon shaft made mining operations impossible. Milling was resumed during the latter part of July, and about 250 men are now employed under the direction of Alex F. Ross, superintendent.

▶ Operations were suspended recently at the plant of Amador Metals Reduction Company, situated on the property of Argonaut Mining Company at Jackson, Amador County, and operated since 1923 by Hamilton, Beauchamp & Woodworth, of San Francisco. Save for the assay, engineering and metallurgical offices, and two residences, all other equipment will be dismantled and removed for storage to the Delta tailings plant, in Jackson Valley, to enable the Argonaut company to store mill tailings. The cyanide plant for re-treating the Argonaut tailings originally was built by W. E. Darrow and associates some 22 years ago.

▶ The Standart mine, near Greenville, Plumas County, operated by the Indian Valley Mining Company, C. L. Hibbard, president, is to be placed in production immediately on completion of the 150-ton milling plant early in September. A considerable tonnage of milling ore is said to be available at the property. Operations are directed by G. L. Johnson, superintendent.

▶ Oakland interests are reported to have acquired the old Franklyn Boldwin mine, at Mountain Ranch, Calaveras County, considered one of the largest open-cut projects in the area. A 1½-yd. shovel is at work at the property, and deepening of the 140-ft. shaft on what is believed to be a continuation of the noted Sheep Ranch vein to 1,200 or 1,600 ft. is planned. E. E. Cunch is manager.

▶ The dragline dredge owned and operated by the R. & M. Mining Company near Plymouth, Amador County, is now handling some 700 yd. of gravel in 24 hours with two shifts working. A. T. Merian, one of the owners, directs operations.

▶ Yuba Consolidated Gold Fields, operating a large number of gold placer dredges in the Hammonton, Folsom, and Snelling placers areas, has ordered what is expected to be one of the largest dredges in the world for the Hammonton field. The new unit, already under construction at the Benecia plant of Yuba Manufacturing Company, will dig some 115 ft. below water against a bank of 40 ft., with 18-cu.ft. buckets on the digging ladder. The hull, 80x250 ft., and superstructure will weigh 1,800 tons. The dredge is expected to be in operation next summer. Officials of Yuba Consolidated Gold Fields include F. C. Van Deinse, vice-president in charge of operations; H. C. Perring, field superintendent; and George Aaronson, assistant superintendent, with headquarters at Hammonton. Stanley M. Bolster is president of the company.

▶ A small rotary furnace is being installed at the Clear Creek quicksilver mine, near Hernandez, San Benito County, operated by W. W. Webster.

▶ Lack of water has forced temporary suspension of operations at the Omega hydraulic mine, near Washington, Nevada County. About 60 men were employed under the direction of Theodore Larsen, superintendent. The second hydraulic project in the district, the Joubert, also will end its season soon because of a diminishing water supply.

▶ Operations were recently resumed at the Tanzy mine, north of Sonora, Tuolumne County, after a three-year lease arrangement was completed between Jack Lawson and E. Erickson and J. O'Hara, Joseph Oneto, and associates, the owners. Terms of the lease call for payment of a 20 per cent royalty. Considerable development work is planned.

▶ The Bell brothers and Robert Smith have taken a lease from the Reliance Placer & Quartz Mining Company and are actively developing the Reliance holdings near Graniteville, Sierra County.

NEVADA

Discoveries in Divide District Attract Interest

Abandoned claims south of Tonopah again relocated—Tungsten mill under construction in Lincoln County—Marigold Mines, Inc., resumes operations

▶ New activity in the Divide district, south of Tonopah, in Esmeralda County, has resulted in several interesting discoveries of high-grade gold ore, notably in a newly opened section of the Tonopah Divide mine and in property of the Verdi Divide Mining Company. In the latter, ore of bonanza grade was opened lately on ground leased by Joseph Clifford, and another rich seam has been found on the adjoining J. W. Van Winkle lease. Several other leases are being worked and claims long abandoned have been relocated over a large surrounding area.

▶ Construction of a 50-ton tungsten mill of advanced design is in progress on property of the North Tem Piute Mining & Development Company in the long-abandoned Timpiute district in western Lincoln County. M. F. Schofield, manager, receives mail and supplies at Caliente.

▶ High-grade gold ore has been shipped by truck in considerable quantity from the Mary Ann mine, in the Douglas district in Mineral County, worked by Charles Johnson and Thomas Thompson under lease from Harry Springer and associates, of Mina.

▶ Claims including the Chollar-Potosi-Brunswick groups, with others that cover the Brunswick lode for over 3,000 ft., have been acquired by purchase or under option by the Gold Shares, Inc., and a shaft is being timbered to the 200-ft. level, on the Chollar section. Clyde E. Collins is in charge for the Gold Shares, Inc., with office at Silver City, Nev.

▶ Operation of its 60-ton cyanide mill has been resumed by the Marigold Mines, Inc., at Unionville, Pershing County. In opening a newly prospected section of its gold property south of Valmy, in Humboldt County, the company is developing an orebody of much promise. Frank E. Horton, of Unionville, is resident and manager.

▶ Ore from the Omco mine in the Simon district, Mineral County, is being trucked to the 150-ton cyanide mill of the Dayton Consolidated Mines, Inc., at Silver City. The Omco gold mine is being worked under lease by L. T. Sheeley, who has

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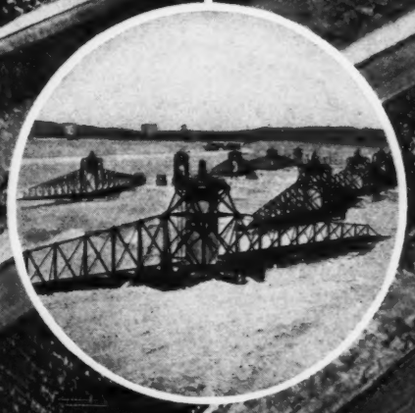


COMPANY

570 LEXINGTON AVE., N.Y.

TORONTO CHICAGO

▶NEVADA

also acquired under lease the Warrior mine, situated east of the Simon Silver-Lead Company's property.

▶ Operation of the 350-ton flotation mill of the Mountain City Copper Company in northern Elko County is expected soon, following a shutdown of several months. A small crew of miners has been engaged in development work during the suspension. Mountain City Copper is controlled (62 per cent) by the International Smelting Company, an Anaconda subsidiary. J. O. Elton, of Salt Lake City, is president and J. J. Lillie, of Mountain City, manager.

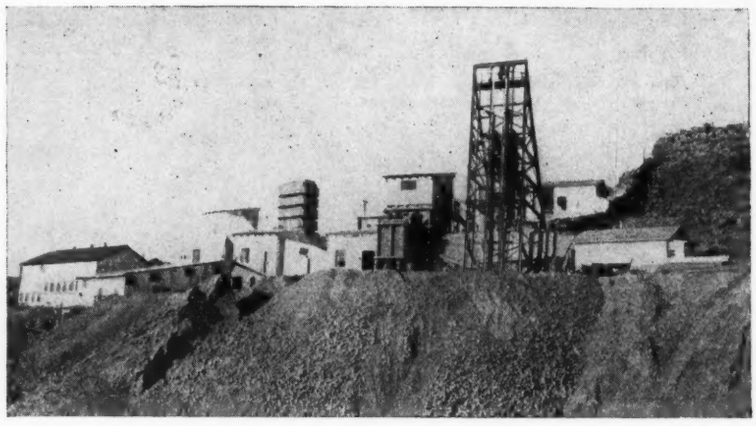
▶ A new vertical shaft has been sunk 250 ft. by the Calumet Gold Mines Company on the old Quartette mine, at Searchlight, Clark County. The ore carries free gold and a little copper. The old No. 3 shaft has been reopened and ore of shipping grade has been broken in raising from the 600 ft. level near old stopes. Fred A. Vollmar, of Silver Peak, is president.

▶ On the Crown Point mine, at Virginia City, second in production among the Comstock lode bonanzas, the cyanide mill constructed last year with rated capacity of 100 tons per day has been treating 120 tons daily. The Crown Point is owned by the Sutro Tunnel Coalition, Inc., wholly-owned subsidiary of the Comstock Tunnel & Drainage Company. J. M. Leonard is manager.

▶ Gold properties situated in Mill Canyon, near the Eureka-Lander County line, owned by the Roberts Mining & Milling Company and by Erich J. Schrader, of Reno, have been acquired under lease by James O. Greenan, a Nevada engineer who returned lately from the Philippines, where for several years he had acted as consulting engineer for Marsman & Company. Acquisition of the properties by Greenan has terminated litigation between the owners of the adjoining groups. The properties are three miles north of the Cortez silver mine. Beowawe is the rail point.

▶ Men reputed to be officers of the Utah Copper Company are said to have acquired an option on stock control of the Rip Van Winkle Mining Company, which has developed large bodies of silver-lead ore in tunnel and shaft workings in the old Merrimac or Lone Mountain district, 28 miles northwest of Elko. L. S. Breckon, geologist for the Utah Copper Company, has been directing a thorough sampling of the property. Edwin Seymour, of Elko, is manager.

▶ Latest Nevada gold district to arouse interest is Cimarron, 30 miles north of Tonopah, in Nye County, where E. M. Booth, Tonopah prospector, found rich ore in vein outcrops in 1935. Early this year Booth's claims were acquired under option by the Tonopah Mining Company of Nevada, but after some surface work the option was relinquished. Booth and his wife (also an able prospector) returned to the district two months ago, and found other veins in rhyolite south of the first discovery. The claims were recently taken under option by the Pacific Butte Mining Company, F. A. Vollmar, president, at Silver Peak, Nevada.



Among properties operated by Veta Mines, Inc., is the one above, about 11 miles from Duncan, Ariz., showing headframe of Shamrock shaft, where silver ore is hoisted and treated in the 100-ton flotation mill

ARIZONA

Copper Mines at Ray and Ajo Resume Operations

Nevada Consolidated Copper and Phelps Dodge Corporation reopen mines closed during summer—Arizona Molybdenum corporation to deepen shaft

▶ The Ray mines of Nevada Consolidated Copper, Kennecott subsidiary, reopened on Aug. 16, after being shut down since the middle of June. Production will be resumed on a curtailed basis, or at about the same rate as that which was in force before the property closed down in June. R. W. Thomas is general manager at Ray.

▶ The annual shutdown of the New Cornelia unit of the Phelps Dodge Corporation at Ajo was shortened from five to three weeks, as operations resumed on a curtailed basis on Aug. 22. H. M. Lavender is manager at Douglas.

▶ The Universal Placer Mining Company, at Wickenburg, is now operating on a two-shift per day basis. James H. Kennedy, at Wickenberg, is general manager. The company is engaged in a portable dry-placer operation. Each set-up is designed to operate in an area 250 ft. in width. Offices of the company are situated at 1421 Chestnut St., Philadelphia.

▶ The Backbone Mining Company, at Arivaca, is shipping selected ore regularly. Owners of the property are contemplating erection of a mill. Claude Clays is in charge of operations.

▶ The Atlas mine, owned by L. M. Kay, is shipping ore to the American Smelting & Refining Company at El Paso, Tex. Mr. Kay is planning to sink the shaft to lower levels.

▶ The "94" Mining Company, at Crown King, Yavapai County, R. E. Drannon, president and general manager, is drifting on the 100 level to develop the ore-shoot north of the shaft. The company is operating the Union and Eagle claims, part of the Saratoga group, under lease and bond from the Phoenix-Saratoga Mining Company.

▶ Swimmer Mining Company has installed a plant on the Gila River, 22 miles east of Safford, for recoverey of gold. Work will begin on the Neel claims under lease to the company. The equipment has a daily capacity of 3,000 cu.yd. Power will be furnished by two large generators located at the plant. A larger plant will be installed later provided the present 3,000-yd. plant proves successful. Patrick O'Grady is in charge of operations.

▶ Cochise Milling Company has leased the tailings of the Commonwealth mine, at Pearce, Cochise County, from J. R. Mattingly and G. A. Martin and has equipped a 100-ton flotation plant on the property. Mattingly and Martin in turn hold a lease from Thomas F. Cole, 1230 South Oakland St., Pasadena, owner of the property. The Cochise Milling Company is composed of V. E. Ryan, George Neville, and Fred Paxton.

▶ Loading facilities are being completed at the mine and railroad for the commencement of shipments of barite from the Ernest Hall property, near Cottonwood Pass, in the Salome district. Shipments have been going forward at the rate of two carloads a month. With the added facilities, Tony Wayahn expects to ship a carload daily to the California Talc Company at Los Angeles.

▶ O. C. Maddux and Frank Bell, of Kingman, have leased the Gold Trails group of claims north of Squaw Peak near Highway 66, 20 miles west of Kingman in the River range. This group of claims is owned by Mrs. Cassie Keys and Mr. and Mrs. Frank Butter. The property was developed some years ago through a 500-ft. shaft with some lateral workings. The leasers propose to drive a tunnel in on the vein, expecting to encounter ore on the way. The tunnel will cut the shaft at its bottom and release 300 ft. of water now standing in it. An excel-

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This new drill is styled after the famous JA-45 and JA-55 Jackhamers which have become so popular since their introduction last year. It fits perfectly into the JA Family which now has a Jackhamer for every class of work. The JA-30 for small, light jobs only; the JA-35 for general light Jackhamer work with an "extra-power" feature for heavier work; the JA-45 for the majority of general jobs; the JA-55 for all-around heavy work.

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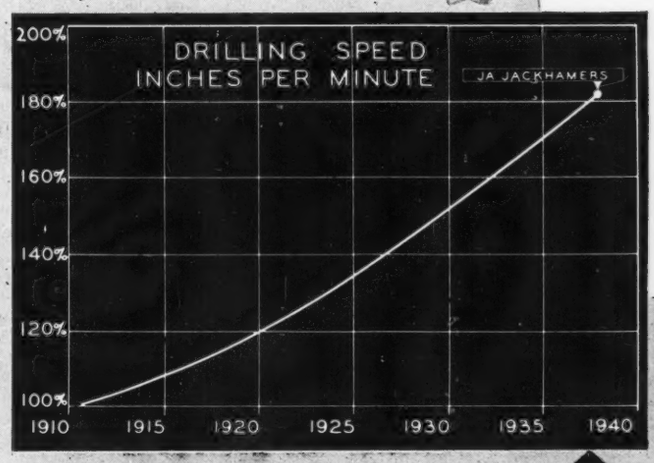

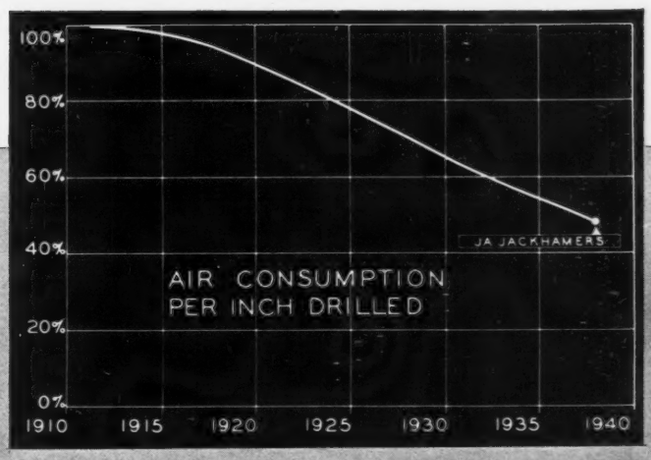

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▶ARIZONA

lent spring of water is near the mine, and the electric power line from Kingman to the Gold Road and Oatman districts passes within a short distance of the property.

▶ The New Year and Mohawk mines, at Mammoth, are producing about 3,000 tons monthly. Molybdenum Gold Mining Company is operating the property. The ore contains molybdenum, vanadium, gold, and lead. K. V. Geib is mine superintendent in charge of operations.

▶ Arizona Molybdenum Corporation, at Copper Creek, is preparing to sink the main shaft to a greater depth. A winze already down about 30 ft. below the 500 level is reported to be in good ore. Mine output keeps the mill running steadily treating around 300 tons of ore per day. A large dump is available for milling should there be an increased demand for molybdenum or vanadium. B. H. Martin is mine superintendent and Truman H. Kuhn is the geologist engaged in the development program.

▶ Nichols Copper Company, 40 Wall St., New York City, has announced a change in its name to Phelps Dodge Refining Corporation. No changes were made in the management personnel.

▶ The Big Horn and Eagle's Nest properties, situated about 15 miles south of Aguila, Moricopa County, operated by Graef and Burkard, are having ground broken for the erection of 50-ton Huntington mill.

▶ Richard de Smet, P. O. Box 151, Kingman, general manager of the Gold Standard Mines Corporation, is reported to have encountered a large tonnage of mill ore in the development work which was started some months ago to pick up an orebody that had been lost by a fault. The shoot was found in the upper levels, and prospecting is being done at lower levels to pick up the downward extension. At present the mill is treating about 240 tons daily with ores taken from the Portland, Arabian, and the Katherine. The company expects to do some development work on the Thumb Butte early this fall.

▶ The Tintic mine, at Chloride, has been taken over by Dr. Roy Martin and associates, of Las Vegas, Nev. The mine is owned by Harold Hawks, of Chloride, and C. F. Schaffer, of Inglewood, Calif. Johnston & Witcher, Inc., operated the property for some months. A considerable tonnage of milling ore is reported in sight. The property is only about two miles from the Tennessee-Schuykill mill, which has recently accepted custom ores for treatment.

▶ A group of placer claims near Constellation, Yavapai County, is being prepared for exploitation by C. B. Hayes. Ditches, trestles, chutes, and sluice boxes are being made and installed.

▶ Jim Ford, of Oatman, and Fred Gannett, of Crescent City, Calif., are planning development of their group of claims in the Union Pass country in Mohave County.

COLORADO

Old Mine Near Leadville Will Be Dewatered

Property of New Elkhorn Mining Company to be examined—New gold dredge being assembled in Bever Creek near Fairplay —Tungsten plant enlarged

▶ After 30 years of idleness, the mine of New Elkhorn Mining Company, in Big Evans Gulch, Leadville, Colo., will be dewatered. This means that eventually the Canterbury tunnel may also be reopened. Operations will be in charge of John N. Becker, and R. T. Walker is geologist. The shaft is 800 ft. deep, yet no attempt will be made to reach below the blue limestone, states Mr. Walker. The shaft is in good condition, with a water level at 130 ft. A surface plant will be erected, electric pumping equipment installed, and the water lowered to the blue-limestone horizon, so the old workings can be made available for examination.

▶ The Continental Electric Dredge has been moved over Hoosier Pass, from Breckenridge to the Beaver Creek area, the placer ground of the Placers Reality Company, Fairplay, Colo. L. J. Cole, of the Stearns-Roger Manufacturing Company, is in charge of assembling the machinery. E. J. Cunningham, representing the owners of the placer claims, is cooperating in the work. Operations are expected to start within two months.

▶ O. H. Stahlin, George S. Turner, and Floyd Edgers have just inspected the Ezra R and other mines under development in Arastra Gulch, near Silverton. Carl Lundberg is directing work of unwatering the shaft and workings of the St. Paul mine, in the Red Mountain section.

▶ The Benson holdings in Eureka Creek and on Galena Mountain have been taken over by Robert West Decker, of Dallas, Tex. S. B. Miles & Son, of Falls City, Neb., and F. M. Merrilees, of Los Angeles, recently surveyed the property of the Sultan Mountain Milling & Mining Company. Mr. Merrilees is consulting engineer for the company. These workings are in Molas Lake country, near Silverton, Colo.

▶ The Crusaders Gold Company has completed its mill at Creede. Maude W. Russell is trustee and general manager. Alva A. Hood is in charge, assisted by Grover Westerman. This property consists of the Sylvanite, Kankakee, and Gold Bug group of claims.

▶ The Metals Recovery Company has started operating the Hunter Creek flotation plant at Aspen, Colo. Otto Johnson and John Slogar are in charge.

▶ The American Smelting & Refining Company on Aug. 1 awarded a contract for an exploration tunnel near the Fairview vein. The drive will be 500 ft. long and will be an extension of present workings. The contract was awarded to Telluride men. Harry J. Johnson, local manager, states that the contractor price for the 6x7-ft. tunnel will be $8 per foot for the first 300 ft. and $8.50 per foot for the last 200 ft. During the late summer the company expects to cut the Florence vein. The Fairview vein is about 7 ft. wide. The project will cut the Silver Chief vein on the Ben Purdy group. Engineers engaged in the project expect to complete the tunnel by Nov. 1.

▶ The Boulder Tungsten Sampler & Refinery, under the management of D. W. Schmidtt, of Boulder, Colo., recently completed an expansion program. The plant is designed to reduce about 1,500 lb. of tungsten ore to tungstic oxide, and results obtained run consistently around 99.8 WO_3. Ore is crushed and passed through a Gyrotor type pulverizer, where it is reduced to ¼-in., then brought to the main room, where it is roasted, leached, precipitated, filtered, and dryed. The plant handles ores running around 25 per cent WO_3 and low-grade concentrates, which are a drug on the market, and it also affords a place in which to convert small lots of high-grade ore into bullion. The high-grade ore is crushed, then ground fine, and placed in an amalgamator, where any free gold is removed; thence it is sent to the conditioner, where it is agitated with reagents and then fed into the flotation cells. Concentrates are then roasted, cyanided, and converted into bullion. F. A. Plummer is superintendent and chemist.

IDAHO

Lease Taken on Gold Bottom Mining Property

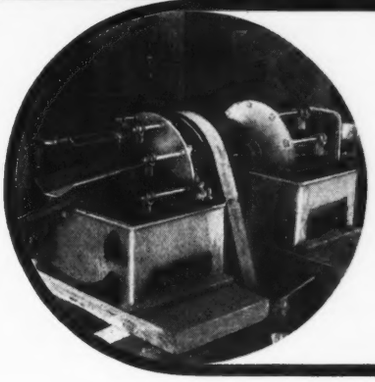
Company may later erect mill—Drilling begins in Red Monarch tunnel—Bunker Hill & Sullivan releases option on Mammoth mine

▶ The Gold Bottom Mining Company, of Bellevue, has leased its property to Lloyd Pratt, of Pomona, Calif., for 99 years, under provisions of a legal instrument filed in the office of the Blaine County recorder. Among provisions of the contract is obligation of the company to erect a mill when development at the property reaches a satisfactory position. Pratt is a mining engineer who set a record for tunnel driving in the Philippines.

▶ After two years of exploration at the Mammoth mine, in the Dixie district of central Idaho, the Bunker Hill & Sullivan has decided to give up its option and lease, according to reports. A 25-ton pilot mill has been in operation testing the ores. The property is owned by Lewiston interests.

▶ The Sunshine mill treated 70,745 tons of ore during the second quarter of the current year, Ross Leisk, manager, reports. The average head assay was 43.2 oz. silver per ton. Concentrates averaged 996.7 oz. and tons of concentrates produced were 3,038. Silver recovered totaled 2,941,344 oz. and the average tonnage daily sent to the mill was 774. Net smelter returns were $1,800,433, compared to $1,829,102 in the first quarter.

▶ Recent development work at the Clay-

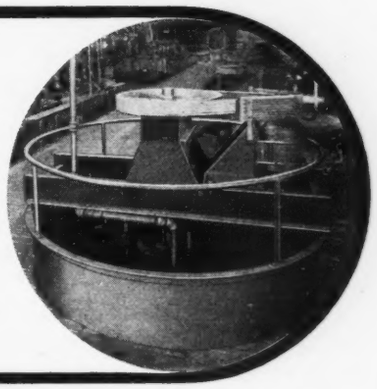


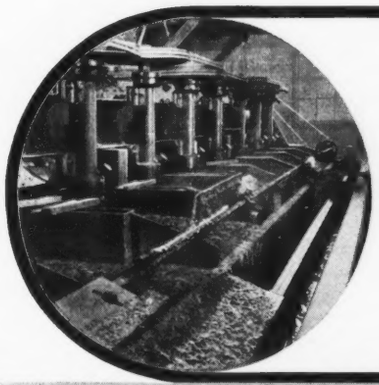
1. Adding Reagents Accurately

When adding reagents in quantities as small as one drop per minute, it necessitates a feeder that can be accurately controlled. Such accurate reagent control is analogous to the care exercised by a pharmacist in filling his prescriptions . . . the ingredients must be accurately measured in a graduate and then mixed in the proper order . . . and likewise reagents should be introduced by feeders which positively control the quantity of reagents fed. This is accomplished with Denver Wet Reagent Feeders by varying size and number of cups, regulating amount tripped, and changing speed of disk.

2. Conditioning Before Flotation

After the reagents have been added, they must be mixed and the necessary time allowed for the chemical or physical reaction to take place since most reagents (such as lime and the heavier reagents and oils) require considerable time and agitation for emulsification and chemical reaction. To do this in the flotation machine is expensive and requires a large number of cells. Thus Denver Conditioners (now built with a low-head superstructure as illustrated at the right) are universally used for this purpose, because they are low in first cost, operate efficiently, and require minimum horsepower.





3. Correct Flotation Conditions

A Denver Conditioner placed ahead of the flotation machine acts as an equalizer and stabilizer, thus providing a constant feed to the flotation cells. As the third and final step . . . after adding reagents and conditioning the pulp . . . . flotation can be accomplished with best results. By having complete control of reagent feeding, the flotation plant can be operated most satisfactorily with the lowest possible expenditure. Check over your reagent costs and see if you cannot better results. There is a Denver Reagent Feeder built to handle every dry and wet reagent problem.

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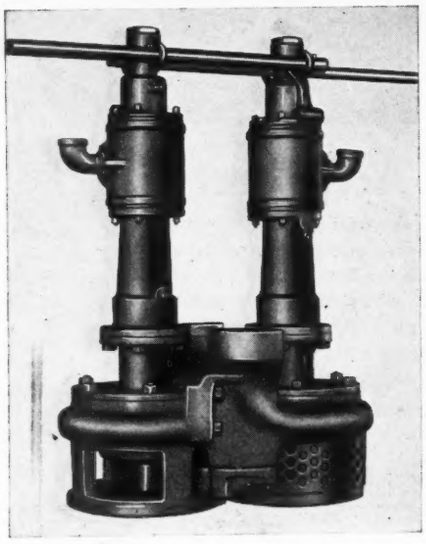

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▸IDAHO

ton silver mine, in Custer County, has been confined to completing a prospect raise between the shaft level and main haulage tunnel level, company officials report. The first crosscut, 35 ft. down this raise, passed through some faulting and struck a face of high-grade milling ore averaging 20 oz. of silver and 14 per cent lead per ton. Ore shipments are expected to increase because of the higher lead content in the mill feed.

▶ The mill of the Thunder Mountain Mining & Milling Company, in Valley County, is operating three shifts and treating about 60 tons ore daily by amalgamation and flotation, according to L. E. Nicholls. Mill heads run from $7 to $10 per ton. The company is opening a lower level and expects to strike high-grade ore soon. Forty men are on the payroll.

▶ "The problem of mine taxation is by no means a solved issue," said Donald A. Callahan to the Geological Society of the Coeur d'Alenes at its August meeting. "A part of the confusion on the issue of mine taxes is due to excise taxes levied against mining which are not charged to other industries. Mining is a depleting industry and assets of mining companies are constantly being wasted. Two conflicting theories for determining depletion value add to the confusion of the general issue. One of these asserts that valuation should be on the present worth of the orebody as determined by visible tonnage and prices. The other insists that depletion value depends solely on yearly production, and this view is the one commonly assumed by the industry."

▶ Drilling operations in the Red Monarch tunnel by the Callahan Consolidated Mines, Inc., are now under way, with Joe Grismer in charge of operations. The tunnel is about 5,800 ft. long and lacks about 800 ft. from reaching the Rex vein system, the object of the drive. The crosscut will cut the Rex vein 200 ft. below the bottom of the Rex shaft on what will be known as the 900 level. A 200-ft. raise will then be driven to connect the workings and prepare the way for shipments from the Rex orebody, which in past operations above the 700 level has yielded more than $2,000,000 in lead, zinc, and silver. Donald A. Callahan is president.

▶ Extending a greeting from the Bunker Hill & Sullivan to the 34th annual Miners' and Smeltermen's picnic, held Aug. 14 at Kellogg, President Stanly A. Easton discussed present day problems and gave the audience an insight into some of the vexing questions confronting the business men of the nation. He placed much of the trouble on mounting tax systems which handicap and discourage business operations, in that they take funds that should go into industry itself. He voiced confidence in the future of the mining industry and said it was his opinion that present restrictions on industry would be eased in the near future. "Our industry in Kellogg has operated for 40 years without a break," he said. "There have been no strikes, no lockouts, and perfect continuity of income has been assured. Most of our workers were born and raised here, and their stake is in this community."

MONTANA

Workers Vote to Continue Wage Contract

Agreement approved to base earnings on sliding scale of metal prices—New freight rate on ore shipped to Tacoma smelter, in Washington

▶ Butte, Anaconda, and Great Falls unions have voted to continue the present wage contract for one year dated from Oct. 1, 1938. Notice of this intention is according to the agreement required 45 days before the expiration date. One division, the Butte Stationary Engineers, No. 83 of the International Union of Mine, Mill and Smelter Workers, voted to open negotiations for a new agreement. The present contract was signed two years ago when the copper price was 9¾c. a pound, with a corresponding base pay rate of $5.25 for miners. A 25c. raise was to become effective when the metal price advanced to 11¼c. and held for 30 days. Additional 25c. raises were to be made for each 1¼c. increase in the copper price. During the period of operation of this agreement, miners' wages reached a top of $6.75 when copper approached the 17c. mark. The present rate at 10¼c. copper is $5.25 a day for miners.

▶ The fourth annual convention of the Montana Mining Association was held at Dillon Aug. 10-11. Carl J. Trauerman, of Butte, was reelected President, and Bozeman was selected as the city in which the 1939 convention will be held. Harry C. Bacorn was reelected vice-president and Charles Brazier, of Helena, appointed second vice-president. August Grunert, of Helena, was elected secretary-treasurer and Dr. F. A. Thomson was made chairman of the executive committee. Current mining problems in Montana were discussed and it was pointed out that the Association had assisted in seeking a settlement of labor difficulties which were responsible for the closing down of the East Helena lead smelter of the American Smelting & Refining Company. A feature of the convention was an ore exhibit of Madison County ores prepared and arranged by Fred W. Bleck and Frank E. Blair, of Virginia City.

▶ A new sliding-scale freight-rate schedule on Montana ores shipped to the Tacoma Smelter became effective Sept. 9, 1938. Similar rate negotiations have been in progress toward lowering shipping costs to Salt Lake and Kellogg, Idaho, during the period that Montana smelters are closed.

▶ A new tunnel development is reported to have been started in the Neihart District to test the extension of the Queen-Galt vein in property owned by Victor Nelson. Recent developments at the

Florence mine have been encouraging in terms of the future of the district and the success of the Nelson tunnel would be especially important in this regard. It has been reported that plans are being considered to enlarge the 75-ton mill operating on the Big Seven mine, which produced in 1937 approximately $100,000 under the management of Charles Weathered.

UTAH

Labor Contract Help Up By Union Officials

Agreement would have raised wages for many Utah miners on Aug. 24; seniority clause held unacceptable—Test holes being drilled ahead of Elton tunnel

▶ On Aug. 13, previous to the acceptance of the two-year wage agreement by the five mining companies, a bombshell was thrown by the executive board of the International Union of Mine, Mill and Smelter Workers, when it announced at Butte, Mont., it would not accept the contract just ratified by a referendum vote of 5,900 workers and unanimously recommended by local union officials. The executive board in a letter to Chairman W. M. Knerr of the Utah Labor Relations Board recommended that "no local union sign the agreement," chiefly on the ground that the seniority clause in the contract is "considered entirely inacceptable and in violation of the Wagner act."

▶ Sale of 150 acres of mining ground at Bingham to the Utah Copper Company for dumping and trackage purposes for $350,000 is said to assure the National Tunnel & Mines Company funds for completion of its 23,000-ft. Elton tunnel between Bingham and Tooele. Work on the adit was halted some time ago by a heavy flow of water at the 6,100-ft. mark. The company is now drilling test holes ahead of the bore to find bedrock. The ground sold belonged to the New Bingham Mary Mining Company and the Boston Apex Mining Company, subsidiaries of the National Tunnel & Mines Company.

▶ Grand Central mine, at Mammoth, in the Tintic district, closed down on Aug. 20, throwing 35 men out of employment. A surplus of siliceous ores at Salt Lake Valley smelters of American Smelting & Refining caused the shutdown.

▶ Silver King Coalition Mines Company reported a net loss of $71,857.55 for the quarter ended June 30, 1938, after all taxes and depreciation but before depletion. The loss was attributed to the shutdown continuing since April 30. For the year ended June 30, the company reported a net profit of $591,735.94, or 48.5c. a share on 1,220,467 of common stock outstanding.

▶ On Aug. 24th, Utah Copper Company employees at the Magna and Arthur mills voted on the question whether they wished to be represented by the I.U.M.M.S.W. or the Independent Association of Mill Workers. Results will be announced from Washington, D. C.

THE *Dredgeman's* *Notebook*

Oval—18 cu. ft. buckets dig 77 ft. below water level on this Yuba gold dredge. Note mud pump discharge at stacker tip.
Left—The Perry Bucket Idler* balances the long bucket line, reducing wear.

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NEWS FROM Washington

By Special Correspondent

RESULTS OBTAINED by the President in his political "purge" have dual significance for all industry. First, they will determine the extent of further reform legislation in the next Congress. Second, they will largely affect the control of the Democratic party in 1940.

The President is not at all satisfied with the extent of reform progress. He has no intention of using the next two years to consolidate his position and make secure the advances now on the statute books. He will demand further reorganization of the Government agencies for more complete control by the Executive. He will strive further to weaken court reviews of administrative decisions. He will continue the pressure for further Government regulation of business.

All this is business news of prime importance. It may be a determining factor in the extent of Federal regulation of mining, a fond desire of the Reformer-in-Chief. It surely will influence the rate at which new regulation of mining takes place, in money, labor, resource control, and even perhaps direct entry of the Government into mineral industry (for example, phosphates). The partisan political significance is relatively unimportant, except to the individual politicians.

Wage-Hour Rulings

THE FAIR LABOR standards law which fixes wage and hour limits for all employments affecting interstate commerce will apply in practically every division of the mining industry. Just how it will apply will be determined in large measure by the rulings of Administrator Elmer F. Andrews. That official assumed his duties in Washington a little after the middle of August. The law takes effect on Oct. 24, with full force in almost every particular.

Of first importance to the mineral industries is the matter of classification. The law requires that the administration of labor standards be by industries. This classification of business activity is to be made by the Administrator, who, the law says, "shall as soon as practicable appoint an industry committee for each industry engaged in commerce or in the production of goods for commerce." No one knows how many industries there will be in the mining business. That is an important question which will govern many of the details of later handling of wage, hour, and over-time-pay questions.

A great many business men have assumed that the industry will itself select certain representatives to sit on the industry committee. That is not true. The spokesmen for the employers, just like the spokesmen for the public and employees, will be selected and named by the Administrator. No one expects Mr. Andrews arbitrarily to ignore recommendations of an industry as to its employer members of the committee. But there is nothing to bind him to the acceptance of such suggestions.

Often overlooked in consideration of the law is the clear statement of the responsibility of this industry committee with respect to findings regarding wages and hours. The committee is required by the law to recommend for each reasonable classification within an industry "the *highest* minimum wage rate" that will not substantially curtail employment and not give competitive advantage to any group in the industry. In other words, if there be evidence that 40c. an hour as a minimum could be put into effect immediately without curtailing employment, the committee must recommend this, and the Administrator must fix such high minimum. In other words, it need not be seven years before the 40c. wage becomes a requirement. Nor is it likely to be that long in any industry for which higher minimums seem feasible of early achievement.

The mining industry is not likely to have very many exemptions from the application of minimum-wage and maximum-hour provisions. There are few, if any, seasonal industries in the mining business. And none of the more specific exemptions which apply to dairying and other agricultural industry appear to stretch even to the edge of mining or metallurgical activities.

The lack of numerous rulings by Administrator Andrews appears to have deceived many people into the belief that there is nothing doing at the Wage-Hour Standards headquarters. That is not a correct interpretation. That office is, and will be, very busy indeed. And its objective of raising wages and lowering hours will be aggressively pursued for mining as well as for all other kinds of business.

Intrastate Gold Mining

SOME Washington observers have been making quite a point that gold mining is an intrastate business because of a decision rendered by the Circuit Court of Appeals in the case of the Idaho Maryland Mines Corporation, of California. That company produces gold and sells its entire precious-metal output to the Federal mint within the same State. The court, therefore, held that in this case gold mining was an intrastate business, and the National Labor Relations Board had no control over the labor organization or working conditions involved.

Subsequently, in other cases other mining operations have been held subject to Federal regulation. This confused a number of observers who thought that the Idaho Maryland case had given an important precedent, and believed that the later findings elsewhere were in conflict with that California decision.

Some of those who have studied the various cases carefully conclude that there is no conflict. They point out that the Idaho Maryland project is apparently a very special and unusual case in which by mere circumstance of mine location the precious metal does not move physically in interstate trade. That unusual circumstance justifies the finding, which cannot, according to these critics, be expected to prevail for other mining enterprises.

These observers indicate that they think it very unwise to assume any general application for any court decision which would hold that any ordinary mining operation is not in the stream of interstate commerce to such an extent as to be governed by most Federal labor regulations.

Mine-Timber Supply

THE FOREST SERVICE has been somewhat disturbed by the thought that in certain areas local timber supplies might not be adequate for near-by mining enterprises. It has been thought that the increasing use of sawed timbers, in place of round, indicated that the supply of local wood was becoming scarce. A recent forest survey made by W. D. Brush, wood technologist of Forest Service, appears to refute this conclusion. In this connection he states:

"Mine operators, however, report no serious difficulty in obtaining needed timber. This is due in large part to the comparatively short time in which round timbers—particularly the smaller sizes, of which large quantities are used—can be grown on cut-over areas. Many mines have timbered lands which are producing sufficient round timbers for their needs, although the growth is not what it would be with good forest management."

The total consumption of timber in mines varies much in the same proportion as the mineral output of the industry. However, this survey disclosed that a number of factors tend slowly to reduce the quantity of timber required per ton of ore or coal produced. Among these factors are:

1. Open-pit or surface mining, which now accounts for about 12 per cent of total mine output.

2. Introduction of mechanical equipment, such as conveyors, and mechanical loaders and quicker exploitation and abandonment of a particular place in the workings, also reduce timber requirement. Such changes have not as yet had a large influence, the survey concludes.

3. The use of treated timber materially increases the life, and thus the rate of consumption per year.

4. The use of steel and concrete, in place of wood, especially in large mining operations, reduces the timber requirement in the more permanent sections of mines. But at least two-thirds of the mine timbers are used in temporary locations at which treated wood, steel, or concrete are not economically justified. Substitution is, therefore, not likely to affect most mine consumption.

Data from the survey indicate an average consumption of 0.532 cu.ft. of mine timber per ton of mineral produced in 1905. By 1923 this was reduced by one-third to 0.351. But more

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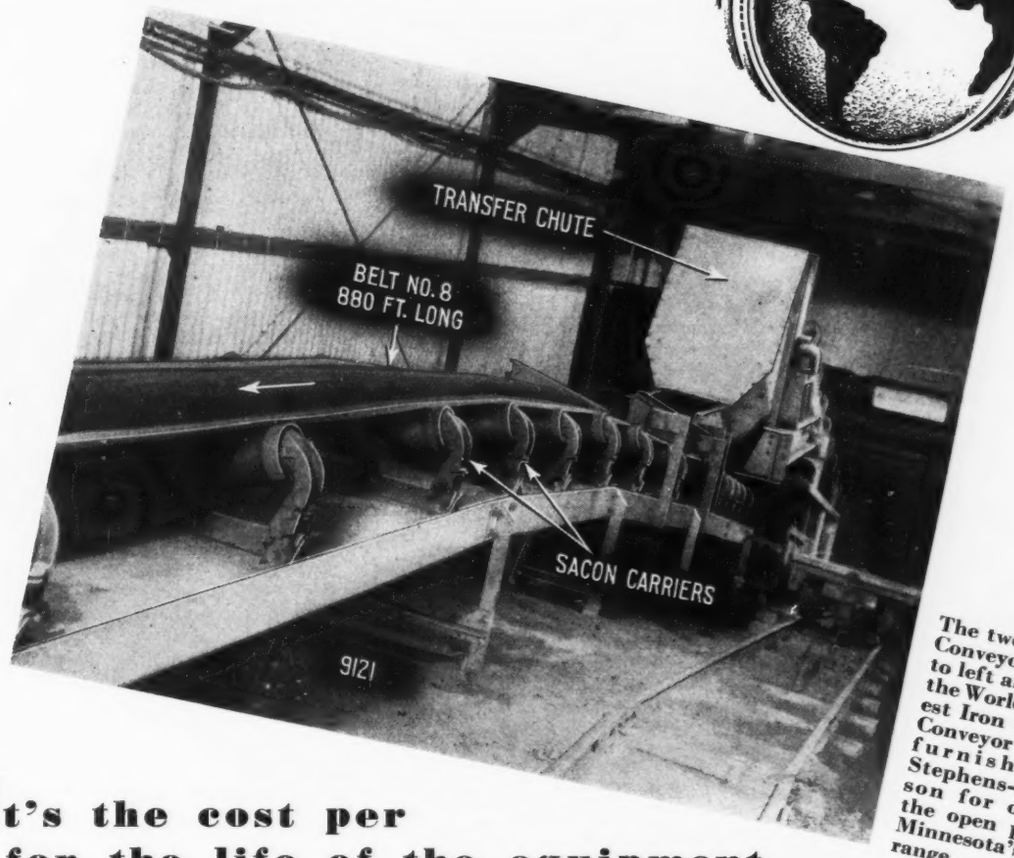

The two S-A Belt Conveyors shown to left are part of the World's Longest Iron Ore Belt Conveyor System, furnished by Stephens-Adamson for one of the open pits of Minnesota's iron range.

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recent operations indicate for 1935 an average of 0.426 cu.ft. per ton. It is thought, however, that this last figure is higher than normal, because a considerable amount of deferred maintenance work was done in 1935. An actual average under 0.40 appears indicated for the mining industry as a whole. On this average the total timber requirement is estimated, therefore, at about 270,000,000 cu.ft. of timber per year. A trifle less than one-half is round, a trifle over one-half is sawed timber, at present.

Mexican Mine Taxes

OFFICIAL WASHINGTON finds difficulty in determining any basis on which it can protest against the new Mexican taxes on minerals. These were, in effect, to impose a 12 per cent tax on all exports of products from mines. The objective was to secure immediate cash income from the mining industry, in order to replace government revenues which had been cut off by expropriation of the petroleum industry. Almost immediately after the imposing of this levy of new taxes by the Mexican Congress, it was noted that so high a percentage as this would virtually prevent the mineral products of Mexico entering world trade in competition with like products elsewhere. The alternative was then proposed of applying the 12 per cent to some "local" valuation. Thus, if the local value of a metal were taken to be just half of its export value, the tax would be only 6 per cent in fact, though nominally 12 per cent on this fictitious base.

Non-Metallic Opportunities

THE NON-METALLIC MINERALS of America urgently need the superior technology which has given such success to the metal mining industry. This is frequently the theme of the discussion by some of the mining engineers and mineral economists in the Government service. Through their field studies they recognize that the mining men and the mining machinery serving the metal industries are generally far more advanced in technology than those in the non-metallics field. They believe also that there is urgent need for "money with a long vision" for the development of non-metallics.

In a number of commodities the technology "seems to ignore quality of product." This means that the producers of non-metallics are frequently merely worshipping quantity as a business objective. This may be all right in the sand and gravel business for the construction industry, but Government specialists do not think that it is sound for other non-metallics. These Government men are wondering whether one of the real advances which might be made in the South does not relate to some of the important non-metallics which occur there in quantity. They point to the successful use of flotation and beneficiation of phosphate rock as a good example which might well be followed by other Southern non-metallics producers.

The apparent importance of this to the mining industry lies in the possibility that professional advancement and profit opportunities both may come from further exploitation of jobs for men and machinery (and for long visioned money) in these laggard divisions of the mineral business.

Alternate to Monopoly

EVEN NEW DEAL REFORMERS are expected to give serious thought to the proposals of A. A. Berle, who has filed a very forceful memorandum with the monopoly inquiry, at its request. In this report Berle takes issue with many of the conventional economic concepts about monopoly. He makes a clean-cut case in demonstration of the need for formulating a substitute for monopoly if we are going to destroy that form of industrial unit. He also points out that mere shotgun regulation as a control for monopoly is not useful unless the regulation has within itself clearly defined and defensible objectives.

He asks for a substitute in business organization that actually works. He urges that any substitute be tested as to "whether it supplies the existing and developing wants of the people as they appear." He demands "the provision of an adequate supply of goods." He urges a distribution system "that takes these goods towards known wants to the maximum degree possible."

All this constructive comment assumes that "the system must provide a maximum number of people with means of satisfying those wants through a contribution to the system" and "that the system must provide the people engaged in the process with a manner of life which at least tends to satisfy a fair proportion of their wants."

And, to the embarrassment of the ultra-left reformers, Berle urges that any new organization must "not interfere unduly, actually or potentially, with the liberty of the individual—that is, that its controls must release more individuality than they suppress."

All this philosophy, coming from one in the important post of adviser to the Chief Executive which is occupied by Mr. Berle, indicates that the monopoly inquiry may become constructive—not merely a trust-busting affair. The fact that Mr. Thurman Arnold, chief of the anti-trust division of the Department of Justice, is known to hold somewhat similar views is very encouraging to business observers of Washington.

News "Fines"

Idaho Phosphate—Defeat of Senator Pope, of Idaho, in the Democratic primaries of August greatly reduces the political pressure for Western phosphate development. The fact that TVA engineers are also under fire cools their enthusiasm for immediate action. Nevertheless, there remains a fair chance that Western phosphate resources will be studied, presumably under the leadership of TVA chemical engineers. But there is almost no remaining chance of immediate entry of the Government into this mineral industry as a manufacturer.

Taxes or Inflation—Senator Harrison, chairman of the Senate Finance Committee, on his return to Washington in August forecast that unless business improves rapidly new and heavier taxes will be levied in the next tax law revision which Congress is expected to pass next spring. The more conservative members of the Democratic party are beginning to believe that politically unpopular increases in taxation are less dangerous than the inflationary threats which perennially rise whenever Treasury deficits are debated. It is certain that the La-Follette philosophy of lower exemptions in personal income taxes and higher rates for those of medium income will be seriously considered. There is fair chance of adoption of this plan because it is the only available source of large new income which Congress has yet discovered.

Monopoly Prosecution—Some persons have feared that testimony before the Congressional monopoly committee might furnish a factual basis on which they would later be prosecuted by the Department of Justice. To allay this fear, Assistant Attorney General Arnold has definitely promised that there will be no such action. Witnesses will be subpoenaed, and therefore forced to testify, which in effect gives a certain protection against subsequent use of this testimony in lawsuits.

Fluorspar—Investigators of the United States Bureau of Mines and the Illinois State Geological Survey have surveyed the fluorspar industry and presented a large summary report. This forecasts that although steel industry consumption of fluorspar may dominate the market, acid and ceramic grades are now much more important and likely to increase in importance relatively. The danger of reserve losses is emphasized "if production ever falls to the point where mines are closed before the deposits are exhausted." Abandonment of such properties, it is feared, might materially reduce the recoverable supplies otherwise economically mined.

Jitters at NLRB—The decisions of the National Labor Relations Board have been so much subject to court reversal, and even more to public criticism, that officialdom in that neighborhood has a bad case of the jitters. This does not in any way appear likely even to temper the vigor of the decisions. But something may come out of the charge of too close affiliation between the Board staff and CIO spokesmen, especially since CIO seems to have been very ineffective politically in the 1938 primaries.

"Yes, but . . ."—Political forecasters of Washington are having a difficult time this summer in interpreting the vitriolic attacks by the President and his close advisers against orthodox Democrats like Senators George, "Cotton Ed" Smith, and Tydings. Some have even gone so far as to say that business men should welcome this out-in-the-open break because it will lead to a showdown regarding control of the Southern Democrats. Self-appointed interpreters for business are saying freely in the Capital that they would rather see a "Yes, but . . ." Democrat in office than an ineffective Republican newcomer.

Minerals Yearbook—The 1938 edition of the Bureau of Mines Minerals Yearbook appeared late in August. Again this year there will not be any appendix. Revisions of the "final" statistics published in the Yearbook will, therefore, be made in the next year's issue.

Approved Mining Loans by RFC

As of Aug. 6, 1938

Location (County)	Applicant	Amount Approved
	ALASKA	
Woodchopper.	Alluvial Golds, Inc. ..... Ernest N. Patty, Pres., Fairbanks, Alaska	$280,000
Bethel Recording Post....	Goodnews Bay Mining Co..... R. W. Vinnedge, Secy., North Bend, Wash.	600,000
Fairbanks Mining District.....	Harry L. Wood..... Box 140, Fairbanks, Alaska	20,000
Chitina.....	Middle Fork Mining Co.. 803 Artic Building, Seattle, Wash.	20,000
Forty Mile District....	E. W. Griffin and W. A. Hesse..... Juneau, Alaska	80,000
	ARIZONA	
Santa Cruz...	Max Ritterrath..... 391 S. Madison Ave., Pasadena, Calif.	20,000
Yavapai.....	Southwestern Metal Mines, Inc..... Cleator, Ariz.	85,000
Cochise.....	R. Robert Meier..... Star Route, Hereford, Ariz.	8,000
Yuma.....	Eugene B. Hart..... Blythe, Calif. via Cibola	12,000
Yavapai.....	Silver Cord Mining Co... A. D. Roberts, Pres., Phoenix, Ariz.	20,000
Yavapai.....	Eastslope Mining Co..... L. L. St. John, Mgr., 4260 Arcola Ave., North Hollywood, Calif.	10,000
Maricopa.....	H. H. Linville..... 53 West Willetta St., Phoenix, Ariz.	5,000
Maricopa.....	Fortunate Fields Mining Co..... J. R. Fleming, Vice-Pres., 28 South 3d Ave., Phoenix, Ariz.	15,000
Yavapai.....	Steve Loncar..... Constellation, Ariz.	5,000
Yavapai.....	Liberty Hill Gold Mines, Ltd..... R. P. M. Davis, Pres., 2356 Hollyridge Drive, Hollywood, Calif.	90,000
Yavapai.....	Russell D. Samson..... Hillside, Ariz.	4,500
Yavapai.....	Congress Mining Corp... John G. Schork, Pres., 100 Broadway, New York, N. Y.	140,000
Yavapai.....	Grove & Sons Mining Co. T. J. Byrne, Correspondent, Prescott, Ariz.	20,000
Maricopa.....	Alfred Strong Lewis..... Cave Creek, Ariz.	12,000
	CALIFORNIA	
Placer and Butte.....	Gold Hill Dredging Co... 311 California St., San Francisco, Calif.	440,000
Mono.....	Thos. R. Hanna..... Martinez, Calif.	45,000
Sacramento...	Guy M. Standifer..... 904 Balfour Bldg., San Francisco, Calif.	350,000
Mariposa.....	Whitlock Mines Corp.... 141 Milk St., Boston, Mass.	20,000
Inyo.....	Ralph P. Merritt..... Independence, Calif.	20,000
Shasta.....	Greenhorn Mining Co.... 109 Crocker Ave., Piedmont, Calif.	19,000
Siskiyou.....	Northern Placer Mines, Inc..... T. H. Pletsch, Sec.-Treas., 146 S. Berkeley Ave., Pasadena, Calif.	9,000
Inyo.....	Golden Princess Gold Mining Associates..... Frank J. Irving, Mgr., Norman Manor Apartments., San Bernardino, Calif.	20,000
Mariposa.....	Fred W. Draper..... 2351 Ramona St., Palo Alto, Calif.	20,000
Tuolumne....	Densmore Gold Mines, Inc..... W. Coburn Cook, Secy., No. 6 Berg Bldg., Turlock, Calif.	20,000
Imperial.....	Tellurite Gold Mining Co. General Delivery, Winter Haven, Calif.	20,000
San Bernardino.....	Fred B. Piehl..... 117 W. 9th St., Los Angeles, Calif.	20,000
Stanislaus....	Tuolumne Gold Dredging Corp..... La Grange, Stanislaus County, Calif.	600,000
Yuba.....	Horse Shoe Gold Mining Co..... O. P. Peterson, Mgr., Box 354, Lincoln, Calif.	20,000
Kern.....	James C. and Otto C. Geringer..... Box 71, Mojave, Calif.	20,000
Plumas.....	Simon Hornstein..... 1213 — 39th St., Sacramento, Calif.	20,000
Inyo.....	Gem Mines, Inc..... 11510 South Alameda St., Los Angeles, Calif.	12,000
Siskiyou.....	Frederick A. Hebbard.... P. O. Box 98, Gazelle, Calif.	6,000
San Bernardino.....	H. B. Snyder..... 1203 Cutts Bldg., 706 So. Hill St., Los Angeles, Calif.	20,000
Trinity.....	Carrville Gold Co..... 807 Lonsdale Bldg., Duluth, Minn.	600,000
Inyo.....	James E. Babcock..... 1200 Rives-Strong Bldg., Los Angeles, Calif.	20,000
Butte.....	Oroville Gold Dredging Co..... 2052 Bird St., Oroville, Calif.	160,000
	COLORADO	
Gilpin.....	La Vida Mining Co..... 517 Exchange Bldg., Denver, Colo.	10,000
Gilpin.....	Union Carbonate Mines, Inc..... George E. Collins, Mgr., 307 Boston Bldg., Denver, Colo.	20,000
Gilpin.....	Atlantic Mines, Inc..... 230 Wilda Bldg., Denver, Colo.	14,000
Park.....	Edward W. Ames..... P. O. Box 921, Denver, Colo.	19,000
	GEORGIA	
Lumpkin.....	Southern Mineral Development Co., Inc.... P. O. Box 116, Dahlonega, Ga.	14,000
	KENTUCKY	
Livingston....	Eagle Fluor-Spar Co..... Salem, Ky.	120,000
	MONTANA	
Madison.....	Humphreys Gold Corp... Judson S. Hubbard, Sec., First National Bank Bldg., Denver, Colo.	250,000
Lewis-Clark...	Porter Bros. Corp..... 620 Power Bldg., Helena, Mont.	180,000
Mineral.....	Gold Mountain Mines, Inc..... P. L. O'Neill, Pres., Box 211, Superior, Mont.	20,000
Broadwater...	Omaha Gold Mining & Milling..... No. 3 Kohrs Block, Helena, Mont.	20,000
Madison.....	Claud A. Heater..... Norris, Mont.	8,000
Lewis-Clark...	Perry-Schroeder Mining Co..... 26 West 6th Ave., Helena, Mont.	250,000
Granite.....	Contact Mines Corp..... Philipsburg, Mont.	5,000
	NEVADA	
Story.....	Sutro Tunnel Coalition, Inc..... Franklin Leonard, Pres., 25 Broad St., New York, N. Y.	160,000
Lander.....	Buffalo Valley Mines Co.. John T. Reid, Pres., Lovelock, Nev.	18,000
Esmeralda....	Red Mountain Mining Co. Walter Rowson, Correspondent, E. C. Lyon Bldg., Reno, Nev.	20,000
Mineral.....	General Tungsten Corp... George F. Thompson, Pres., Mina, Nev.	12,000
	NEW MEXICO	
Sierra.....	Lea and Mollohan..... 505 First National Bank Bldg., El Paso, Tex.	6,000
Colfax.....	C. H. Anderson..... Cimarron, N. M.	15,000
	OREGON	
Crook.....	Cram's Inc..... 209 Guaranty Bldg., Portland, Oregon	15,000
	UTAH	
Juab.....	Queen of Sheba Gold Mining Co..... 901 Utah Oil Bldg., Salt Lake City, Utah	20,000
Iron.....	Pietro Aria..... Modena, Utah	20,000
	VIRGINIA	
Goochland....	Moss Mining Co..... George C. Howell, Pres., 53 East Broad St., Richmond, Va.	8,000
Fairfax.....	Virginia Mines, Inc..... George E. Kirk, Pres., 1215 16th St., N. W. Washington, D. C.	14,000
	WYOMING	
Carbon.....	James M. Orr..... 625 E. 16th Ave., Denver, Colo.	5,000

Total amount of mining loans authorized	$12,475,500.00
Total amount of mining loans cancelled	7,305,000.00
Total amount of mining loans repaid	1,127,251.64
Total amount of mining loans active	4,043,248.36
Total amount of mining loans disbursed	3,855,500.00

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TRI-STATE

Some Companies Increase Operating Schedules

Stocks of zinc concentrates in district are reduced as shipments go steadily forward —United Lead & Zinc Company reopens mill—Employment shows some improvement

▶ Heavy shipments of zinc concentrates from the Tri-State district have reduced the stocks in bins by approximately 10,000 tons during August in spite of the increased production, which will average about 6,200 tons per week. Every effort is being made to increase employment without jeopardizing the present strong statistical position of the industry.

▶ Ora Black, president of the Black Mining Company, announced the sale of his interest in the company to M. A. Baird, who now owns the controlling interest in the company. The name of the company has been changed to the Baird Mining Company. The company has been operating the mine and mill on the American-Douthat land south of Cardin and the Montreal mine, one of the early-day bonanzas. Ore from the Montreal mine is trucked to the mill.

▶ The newly organized United Lead & Zinc Company placed its mill on the Kline land, one and one-half miles southeast of Wentworth, Mo., in operation late in July. The mill, which has a capacity of 35 tons per hour, includes a five-cell rougher jig, a six-cell cleaner jig, and four Butchart sludge tables. Part of the mill equipment was taken from the Coahuila mill of the Denney Mining Company northwest of Carthage, Mo. C. F. Denney is manager for the company.

▶ About 40 men were reemployed when the Lavrion Mining Company placed its mine and mill in operation early in August. Sam Ashe is in charge of operations.

▶ Three of the major companies in the field have raised their schedules of operations from three to four days per week, beginning the middle of August. The Commerce Mining & Royalty Company has increased the schedule at its Bird Dog, Blue Goose, See Sah, Webber, and Wilbur; the Eagle-Picher Mining & Smelting Company at its Beck and Central mills; and the St. Louis Smelting & Refining Company at its Ballard (No. 8) mine and mill. Federal Mining & Smelting Company has added approximately 30 men to its payroll by the addition of an extra daily shift to its Muncie mine and mill. This property will work two eight-hour shifts daily.

▶ The Mission Mining & Royalty Company is adding a flotation section to its mill a mile north of Quapaw, Okla. The new equipment will include a eight-cell Denver Sub-A flotation machine, a two-disk 6-ft. American filter, and a 50-ft. thickener. J. C. Heilman is in charge of operations.

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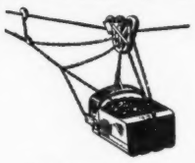
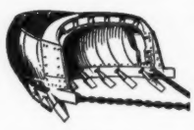


Slackline Bucket



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MICHIGAN

Quincy Mine Producing Higher-Grade Ore

Extensive underground development on lowest levels discloses good prospects for strong ore-reserve position

▶ Quincy is obtaining the largest yield, per ton of rock treated, in its history. The rock is averaging better than 34 lb. copper per ton, the losses being only about 8 per cent, in stamp mill and smelter, of the total copper in the rock as mined. Physically, the mine is in excellent condition. In the lower working levels there are long drifts in virgin territory, which will provide large reserves from which copper will be produced for years to come. No. 6 shaft is opened to the 91st level, and mining is proceeding on the 85th, 86th, and 87th. In the bottom levels of both Nos. 6 and 8, openings are seven miles ahead of mining. Of this large tonnage, 20,000 ft. are of unstoped openings along the Pewabic lode, in advance of stoping operations. All of the ground south of No. 8 for 600 ft. on the lodes and below the 81st to the 87th levels is unstoped ground. North of the shaft, 82d to the 87th levels, a vertical distance of 800 ft. in depth is all virgin territory for at least 3,000 ft., and of practically known high-grade copper rock, being the same as all of the faces of the drift openings to the north from the 87th level to the north end of the 75th.

IRON COUNTRY

Slight Increase in Iron-Ore Consumption

Prospects of higher rate in steel industry may promote more activity at mines during winter months

▶ The consumption of Lake Superior iron ore at furnaces during July amounted to 1,674,721 tons. This compares with 1,471,660 for June, or an increase of over 200,000 tons. The ore on hand at Lake Erie as of Aug. 1 amounted to 35,840,160 tons, compared with 29,151,257 tons a year ago. Shipments of ore from the Lake Superior district to Aug. 1, 1938, amounted to 7,546,775 tons, compared with 34,626,751 tons to Aug. 1, 1937, or a decrease of 27,079,976 tons.

▶ Although operations in the steel industry were scheduled at over 40 per cent at the end of August, this increase will not affect iron-ore shipments, as the season is well under way and any increase would not be reflected in the iron-ore country at this time of the year, as unfavorable weather would affect shipments in all probability during October. However, if the steel industry continues to improve, the betterment in conditions will help the Lake Superior district during the winter months, as it will be necessary to do repairing and some stripping.

MEXICO

Basis for Export Tax on Metals Established

Valuation of non-ferrous metals is below current market quotations—Labor difficulties continue to beset the industry

▶ Watchful waiting is pretty much the order of things in Mexican mining as summer draws to a close. Higher railroad freight rates, a threatened black cloud for the industry, have been suspended, in view of the economic depression. Mining is not free of labor grief. Some smaller companies, such as Cia. Minera de Pedregal y Anexas, S. A., H. W. Fowler, general manager, Taxco, Guerrero, said to operate Mexico's oldest silver mine, whose workers are demanding that their wages be doubled, are in the same fix as Cananea Copper. The Government is doing much to erase labor friction in mining, one of Mexico's largest industries, which employs some 85,000 men in its various branches.

▶ The committee appointed by President Cardenas of Mexico to supervise the collection of the 12 per cent export tax has established the following valuations on non-ferrous metals as a basis for levying the new tax for the period beginning Aug. 10 and ending Sept. 20, or "until amended":

	Pesos Per Kilo
Gold	4,707.500
Silver	32.517
Copper	0.264
Lead	0.108
Zinc	0.065
Antimony	0.546

United States currency equivalents of the initial valuation basis are approximately as follows:

Gold, per oz. troy	$29.2800
Silver, per oz. troy	0.2020
Copper, per lb.	0.0240
Lead, per lb.	0.0098
Zinc, per lb	0.0059
Antimony, per lb.	0.0495

The values announced are, in most instances, well below the prices prevailing in the world's metal markets. Mexican exchange rates have been wholly nominal for several months, owing to the depressed state of business in that country. Officially, the Mexican peso is quoted at five to the dollar. This rate is used in arriving at United States currency equivalents. In addition to the metals listed above, the tax also covers arsenic, mercury, bismuth, cadmium, tin, graphite, manganese, molybdenum, vanadium, tungsten, sulphur (cast, precipitated, or sublimated) gypsum, unspecified mineral fertilizers, and all samples of raw metals and minerals that weigh up to 10 kg. each and have an intrinsic value of not more than 10 pesos ($2).

▶ Labor trouble that threatened a strike has been temporarily smoothed over by Cananea Copper, Cananea, Sonora. This resulted when the Sonora Governor, who flew to the mines, induced the 1,200 miners to accept arbitration of their demands, which include wage increases of from 25 to 60 per cent over the present minimum daily pay of 4.25 pesos (85c.).

▶ Efforts to induce El Tigre Mining Company to reconsider its action of suspending work at El Tigre, Sonora, because of unprofitableness and labor troubles, or to aid the 200 workers thrown out of employment to organize a cooperative society for continuing operations, are being made by the Federal Labor Department.

▶ Work was resumed Sept. 1 by the Cia. Minera La Mexicana y Anexas, S. A., at its mines and mill in the Guanacevi sector, Durango. Ricardo E. Mora is president. Operations were suspended May 1, 1937.

▶ Because antimony is being obtained on properties it holds under concession in San Juan de Copala, San Juan Mixtepec, and Putla municipalities, Oaxaca, Cia. Minera de Oaxaca, S. A., employer of a large number of prospectors and small-scale miners, has asked the Ministry of Finance to allow it reductions in Federal production taxes at the rate of 50 per cent for the first two years of exploitation, 30 per cent in the next two years, and 10 per cent in the fifth year.

▶ Federal troops were sent to Santa Rosalia, Baja California, to prevent disorders by disgruntled miners who accuse the Cia. Minera del Boleo, a French copper-mining concern, of unjustly laying off 450 workers. The Federal Labor Department is investigating the case.

▶ Cooperative exploitation of the Noria de San Pantaleon properties, Sombrerete, Zacatecas, that started last March because the owners found operations unprofitable, is proving successful, according to Pablo Velazquez, manager of the cooperative society. He says that the 980 miners are obtaining an average of 400 grams silver per metric ton, most of which is mined at the 400-meter level, and that a weekly payroll of 30,000 pesos ($6,000) is being regularly met.

▶ Donation of lumber and other material has been made to Hidalgo State by Cia. Minera Real del Monte y Pachuca, S. A., for construction of workshops to make convicts of the State penitentiary self-supporting.

▶ On Aug. 31, a labor strike was called at the Rosita zinc smelter in Coahuila, operated by the American Smelting & Refining Company.

▶ Wind and rain of hurricane proportions swept Monterey, State of Nuevo Leon, late in August, washing out roads and disrupting shipments of concentrates to lead smelters in that city.

▶ Production of metals and minerals in Mexico during the first quarters of 1937 and 1938, in kilograms, according to the Mexican Department of Mines:

	Jan.-March 1937	1938
Gold	6,756	7,533
Silver	714,085	765,456
Copper	13,265,288	11,148,280
Lead	54,878,334	72,011,888
Zinc	27,833,741	46,337,182
Antimony	2,915,468	2,346,356
Graphite	3,076,578	2,141,536
Quicksilver	34,293	83,288
Arsenic	3,185,990	2,516,326
Molybdenum	256,178	197,752
Bismuth	38,160	67,969
Cadmium	37,283	163,843
Tin	102,322	85,261
Tungsten	16,447	9,750
Vanadium	183	26,656

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Recent discovery of gold by Fred Thompson (second from right) in Northwest Territories holds Canadian mining interest. One of the veins is exposed to the water's edge as shown above. Left to right in photo are, E. M. Flynn, C. S. Johnston, Fred Thompson, and J. McCrea

CANADA

Northwest Territories Scene of New Strike

Coarse gold found in quartz veins scattered over large area—Aldermac Copper Corporation to build sulphur refinery—Privateer mill under construction

▶ Gold produced by Canadian mines in June amounted to 390,693 oz., valued at $13,814,904 in Canadian funds. This marks a new all-time record. For the first half of the year, according to the Dominion Bureau of Statistics, gold output was 2,218,168 oz., compared with 1,973,251 oz. for the same period of 1937. Substantially above figures for the United Etates, including the Philippines, this probably indicates Canada's return to second place in gold production.

Northwest Territories

▶ Impressive stories of ten new finds, at least one of them of major importance, have been coming down from the Yellowknife district, an area roughly 70 miles square that lies directly north of Great Slave Lake and including Gordon, Moberly, and Turnback lakes and the Beaulieu and Francois rivers. The resulting field activity has made Edmonton, in northern Alberta, Canada's busiest air base. Daily arrivals and departures number from 25 to 50 planes. The Northern Alberta Railway continues as far as Waterways, 280 miles north of Edmonton. Lake Athabaska, where Consolidated Smelters' Box mine will be in production next year, is 530 miles from Edmonton on the 770-mile air route to Yellowknife. On July 22 the Thompson brothers, Fred and Bob, of Rouyn, Quebec, made a discovery that appears to be better than anything yet seen in the Territories. Coarse gold occurs in quartz on a graywacke island in a small lake 30 miles east of Yellowknife River. A second island 100 ft. away exposes the same quartz 10 ft. wide and 30 ft. long. How much extends under the lake is unknown. Other rich veins have been opened up in the vicinity, where a staking rush has tied up 1,000 claims in a solid block 16 miles long. Murdock C. Mosher, president of Mosher Long Lac Gold Mines, and Roy Lundmark are among those holding strategic positions in the center of this new bonanza field. The Thompsons have been on the ground since last March, financed by a New York syndicate.

Ontario

▶ Barber-Larder Gold Mines has announced an option on treasury stock to Consolidated Mining & Smelting Company of Canada, to finance development work on its property in the Larder Lake district. Shaft sinking has been resumed to open up two new levels, at 400 and 550 ft., under the supervision of H. C. Wilmot, consulting engineer.

▶ The president of Uchi Gold Mines, John E. Hammell, has offered to loan the company all that is required to bring the mine into production, the cost being estimated as well in excess of a million dollars. Under the present program, a 500-ton mill will be built this winter to be ready for operation next June.

▶ Construction of a mill with upwards of 300 tons' daily capacity will be the first responsibility of Walter E. Segsworth, consulting engineer, and D. G. H. Wright, managing director, both newly appointed by the directors of Preston East Dome Mines. The discovery of spectacular high-grade ore has considerably altered the mine picture from what it was a year ago, when reserves were estimated at more than 300,000 tons of $7 to $8 ore above the 200-ft. level and an attempt was made to interest the Hollinger to mill 1,000 tons a day. A vertical continuity of 420 ft. has now been established for the new high-grade vein, between the second and fourth levels. Drifting on the 550 level continues to open up rich material. On Aug. 16, 17, and 18 assays from muck samples ran $124.60, $65.10, and $162.40.

▶ Construction of the 60-ton mill of Straw Lake Beach Gold Mines, near Eno, was started in July and it is expected to be in operation before the end of October. The average grade of ore is estimated at $20.17 a ton, with 19,105 tons indicated above the third level.

Quebec

▶ Reporting on Waite Amulet activities for the first six months of the current year, J. Y. Murdock, president, states that copper-gold to the value of $1,218,-284 was recovered from 59,053 tons of ore, in addition to 13,000 tons of zinc concentrates sent to the stockpile awaiting better prices. Official estimates on the new orebody show 1,850,000 tons of indicated and possible ore, based on the first fifteen drill holes. Four surface diamond-drill machines are in operation to delimit the orebody. The old Amulet orebodies have 300,000 tons available, in addition to 450,000 tons remaining in the Waite section. The Amulet mill is being enlarged to 500 tons and plans for building a new mill are being considered by the directors. The new orebody as now incompletely outlined is estimated to be ample for running a second 500-ton concentrator for ten years.

▶ Dr. E. W. Wescott, chemical engineer, of Niagara Falls, N. Y., has announced plans for building a $400,000 sulphur refinery for Aldermac Copper Corporation, located nine miles west of Noranda. The unit is to consist of two rotary kilns, condensers for sulphur, and equipment for drying pyrite and for drying and preheating air used to oxidize iron. The process has been developed in the research laboratories of Comstock & Wescott, Inc., of which Dr. Wescott is vice-president.

British Columbia

▶ Machinery for a 75-ton mill is now being installed at the Privateer mine, at Zeballos, and it is expected production will commence in September. Gordon S. McDonnell, consulting engineer and representative of Conwest Exploration Company, which controls the property, reports that the following lengths of ore have been developed: at the 1,000 level, 815 ft., averaging 3.28 oz. gold, or $114.80 per ton, across a width of 1.12 ft.; at the 900 level, 620 ft., averaging $163.85 across 1.11 ft.; at the 800 level, west drift, 142 ft., averaging 6.335 oz., or $221.72, across 0.86 ft.; 800 level, east drift, 116 ft., averaging 1.98 oz., or $69.30, across 0.85 ft.; 600 level, 217 ft., averaging 4.16 oz., or $145.60, across 0.54 ft. The crosscut at the 1,100 level is expected to reach the vein soon.

▶ Conwest Exploration Company is also developing the B. X., or Farris, group at Zeballos, where it is reported that in the two tunnels, driven 225 ft. apart, values of several ounces per ton across 6 to 12 in. width are being opened. In one tunnel, 60 ft. of drifting has been done, and in the other, 90 ft.

▶ Development at the Beano group, Zeballos, has been discontinued, and the July payment on the option held by Inspiration Mining & Development Com-

pany, deferred, but the option has not been dropped. Nelson B. Smith, president of Dentonia Mines, Ltd., announces that an option has been taken on the Gold Peak No. 4 group at Zeballos, lying between the Privateer and Goldfield mines.

▶ Proserpine Gold Mines has practically completed arrangements with strong Eastern Canadian interests to finance the development of its property, which extends for 4.2 miles along the Barkerville gold belt southeast of the Cariboo Gold Quartz mine. F. J. Tregillus, of Barkerville, is president.

▶ An extensive program of development is being followed at the Ymir Yankee Girl mine with the object of determining whether to deepen the mine and revamp the lower workings, and make certain changes in the mill to bring about a more efficient operation. Meanwhile, it is estimated that there is sufficient ore indicated for three years' production at the present rate of 110 tons a day. L. G. Morrell is manager.

▶ Reward Mining Company has ordered the first 20-ton unit of a new mill for its property on Porcher Island, replacing the 25-ton plant destroyed by fire.

▶ Surf Inlet Consolidated Mines produced gold to the value of $189,315 in the fiscal year ended on June 30, 1938, and earned an operating profit of $48,461. A. H. Sawyer, president, reports that options have been secured on groups adjoining the company's present holdings on Princess Royal Island.

PHILIPPINES

Mining Tax Legislation Postponed Pending Study

New commission will investigate basis for long-range tax plans—Nickel and chromite ores found in large iron deposit—Gold production climbing

▶ The postponement by President Manuel L. Quezon of the consideration of any new tax legislation, announced July 22, 1938, gives a more favorable aspect to the Philippine mining situation, so far as the Government is concerned. The Commonwealth leader announced that he was creating a tax commission for the purpose of studying tax measures before they are submitted to the Assembly for action. This action was a turn-about from the announced proposal to push through eight tax measures which would have netted the Government not only the 6,000,000 pesos needed for specified activities, but more than double that amount. Actual tax collections in the Islands to date have exceeded estimates, official reports stated. The new tax commission will draw up a long-range tax program covering the needs of the Government, for a period of ten years, taking into account probable increases in governmental outlays due to general economic growth on the Islands. Thus the fears of mining operators were set at ease, for a year at least.

A memorandum of the Philippine Chamber of Mines lists taxes paid by the mining industry for the past five years:

	Amount Paid, Pesos	Increase Over Previous Year, Pesos
1933	874,000	.....
1934	1,193,000	319,000
1935	1,433,846	240,846
1936	2,203,723	769,877
1937	3,749,585	1,545,862

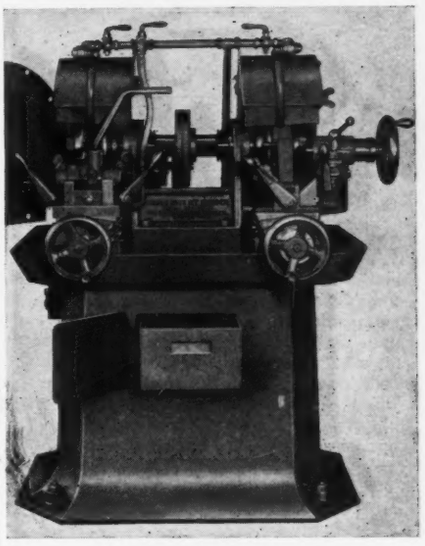
▶ Based on the gold production for the first four months of 1938, it is estimated that the total gold production for this year will be around 62,000,000 pesos, and, with several new mines to come into production, may reach 71,000,000 pesos in 1939.

▶ Another important concession made by the Commonwealth Government to the mining industry was the approval early in June of a bill providing for the issuance of a temporary permit before a lease is granted, to mine or extract minerals subject to payment of royalties. It authorizes the holders of mining claims located under the Act of Congress of July 1, 1902, to extract minerals without such temporary permit until their application for lease is acted upon and (this provision affects the large producers) it empowers the Secretary of Agriculture and Commerce to cancel temporary permits and to stop extraction of mineral, without responsibility on the part of the Government, as to expenditures for development work and exploration purposes and extends the period from two to four years within which application for a lease on a mining claim may be filed from the date of its registration. In this bill, however, is the provision that application for a lease on a mining claim must be filed within four years from the date of the recording of the claim in the office of the mining recorder or within four years from the date of approval of the bill. Failure to file such application within the specified period shall be considered an abandonment of the claim, and the land covered by such claim shall thereupon be open to relocation in the same manner as if no location had ever been made. The original locator who thus fails to file a lease application on the claim shall not be entitled to relocate, directly or indirectly, the land embraced within such claim, or any part thereof. This bill will force the mining companies to adopt the leasing system which has been a bone of contention since it was made a part of the New Mining Law approved late in 1936. In general, however, the legislative actions have been interpreted favorably by the mining industry.

▶ On Aug. 1 short selling and trading in futures (forbidden since 1936, when short selling was blamed for the market collapse) were resumed at the Manila Stock Exchange under rules based on those of the New York Stock Exchange, which are planned to prevent bear raids or manipulative activities. An amalgamation of the Manila and the International Stock Exchanges is being contemplated, and it is generally felt that there will be but one exchange in operation in the near future.

▶ Gold production has grown steadily during the first half of 1938. The monthly output went over the 5,000,000 peso mark for the first time in March, and

the **MASSCO 38 Grinder**



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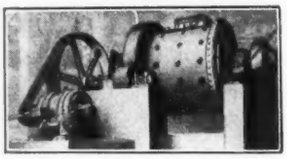

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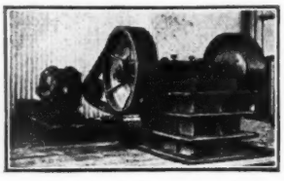

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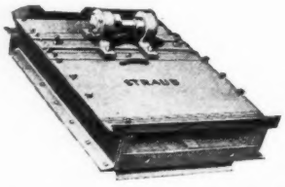

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▶PHILIPPINES

each month since has seen the establishment of a new high record. At the end of the period the total production was nearly 31,000,000 pesos in gold and silver, nearly 25 per cent more than the output for the same period in 1937. Two new milling plants were brought into production during the second quarter of the year, those of Santa Rosa, in the Paracale district, and Masbate Goldfields, on the island of Masbate. Work on two milling plants is well under way. Southwestern Engineering of the P. I. is handling the Capsay and the North Camarines construction. Announcement has been made of the expansion of the Balatoc Mining Company's 1,200-ton-a-day mill to 2,000 tons' daily capacity, the increase to be effective early in 1939. Benguet Consolidated is planning further milling capacity, although complete details have not been announced.

▶The National Development Company (Commonwealth industrial organization) is working actively on the development of the iron deposit in Surigao, in northern Mindanao. On his return from a recent inspection trip to the property, Dr. H. Foster Bain, advisor on mining to the Philippine Government, reported that a billion or more tons of iron ore were available. He reported that exploration work on the property had been completed, and that a report based on geological data obtained would soon be submitted. He said that, at Surigao, according to the average of some 3,000 analyses of samples taken, the average iron content is 47.34 per cent; aluminum, 8.89 per cent; chromite, 3.78 per cent; nickel, 1 per cent; moisture, 40 per cent. The large amount of moisture will probably make it necessary to install a drying plant. Dr. Bain, in a note to the *Engineering and Mining Journal* correspondent in Manila, stated: "On behalf of the National Development Company the Bureau of Mines has been making a detailed survey of a portion of the Surigao iron reserve. A large-scale topographic map has been made, several hundred drill holes have been put down, and systematic sampling has been conducted, with the result that some 50,000,000 tons of accessible ore has been blocked out, near an excellent harbor now being surveyed in detailed by the Coast and Geodetic Survey. The particular body of ore outlined is but a small portion of that in the reserve. The ore is a laterite similar to that found in North Cuba, and like it contains chrome and nickel. Mr. C. J. Horn, of the Stephens Adamson Company, is making engineering plans and preparing specifications for the necessary mining plant, which will be of open-pit type. The Government rejected an offer [from Japanese interests] to lease the property on a royalty basis and these various studies are being made preparatory to opening the mine and selling the ore, when a satisfactory contract for its purchase is concluded. Early in July, General Manager Gregorio Anonas of the National Development Company, accompanied by various engineers, left for Surigao to make a field inspection." Negotiations with Japanese interests are being carried on. It is reported reliably that at present Japanese smelters are not designed to handle iron ore containing as much chromite as the Surigao ore has, and that the smelting plant will have to be redesigned if Philippine ore is to be treated. In view of Japan's present military operations in China, some observers believe she is in no position to finance the purchase of iron ore on a large scale.

AFRICA

German Mining Company Declares Dividend

Property reopened two years ago maintaining steady operations—Government of South Africa seeks to encourage new mining enterprises

▶Otavi Mines & Railway Company, the German company operating in Southwest Africa, made a profit of £36,899 for the year to March 31, and is to pay a small dividend, Rm. 0.50, against Rm. 0.65 last year. After a long period of idleness this company resumed operations two years ago.

▶The policy of the Union of South Africa Government, as outlined by the Governor General, will be to give encouragement to new mining enterprise, both precious and base minerals, particularly in districts where the mining industry is now firmly estalished. From this observers believe that the Government realizes taxation of mining has been carried too far.

▶Roan Antelope's operating profit for the three months to June 30 was £294,500, and after allowing £50,000 for replacements and obsolescence, was £244,500, subject to taxation. The June quarter completed its fiscal year, and the management estimates net earnings at £1,574,000 after allowing £200,000 for depreciation. Roan appears to have been producing recently at the rate of about 6,235 long tons of blister copper monthly, and the recent reduction of quotas will reduce this to 5,205 long tons monthly from July 1; but the higher price for copper is expected to offset the loss resulting from decreased production.

▶The estimated working profit of Mufulira Copper Mines for the quarter ended June 30 was £230.000, or £197,500 after allowing £32.500 depreciation. Estimated profit for the year to June 30, after deducting £130,000 for replacements, was £968,000, subject only to taxation. Apparently, Mufulira had increased its production to about 5,480 long tons of blister copper per month, and under the quota beginning July 1 production will be 4,570 tons monthly.

▶Rhokana Corporation estimates its net profit for the year to June 30, after debenture interest, depreciation, and development reserves, at £1,950,000. Production for the year was 76,275 long tons of copper, 32,028 tons of electrolytic and 44,247 tons blister; and this rate of output will not be changed appreciably by the recent reduction of production quotas.

▶Nchanga Consolidated Copper Mines has issued its first annual report. In-

terest on its huge cash deposit paid all running expenses and left a credit of £11,001; but capital expenditures reduced the £3,000,000 with which it started business to £2,447,410 and £2,308 of investments. Its two incline shafts, one for pumping and general services and the other for haulage, had reached depths on March 31 of 1,657 ft. and 2,259 ft. respectively, and its Chirgola vertical shaft, after being stopped temporarily for the installation of equipment, was down 190 ft.

SURPRISE IN CORNWALL

CORNWALL, ENGLAND, supplies a first-class mining sensation. Polberro Tin, Ltd., last year purchased a derelict mine near St. Agnes for £20,000, an old property which legend says was worked by the Romans and from which some ore was mined as recently as 1880. A few weeks ago miners succeeded in reaching the bottom level, at a depth of 740 ft., and found the shaft in ore which assayed 5.4 per cent tin oxide over a width of 3 ft.

DRIFTING BEGAN immediately, and at last report the vein had been exposed for a length of 18 ft., for which distance it averages ½ per cent SnO_2 over a width of 3.5 ft. As this is three times the richness of the 1½ per cent ore which is considered high grade in Cornwall, it has created a demand for other derelict mining properties. It may be suggested that this discovery is unique. Was any other mine ever abandoned when the bottom of its shaft was in similarly rich tin ore? As the Chinese say, "It can happen!"

AUSTRALIA

Gold Production Shows Sharp Rise This Year

Output in 1938 expected to be largest since 1916—Good development at Yellowdine—Mount Isa may cease shipping zinc concentrates

▶ Official figures of gold production for the five months to May 31 show a total of 612,245 oz., an increase of nearly 80,000 oz. compared with the same period last year. The indication is for a total yield for the year of over 1,500,000 oz., the highest figure since 1916.

Western Australia

▶At a point 40 ft. below No. 3 level, a diamond-drill bore at Yellowdine has intersected a reef assaying 2 oz. 11 dwt. per ton over a bore length of 9 ft. Two new reefs have been discovered recently in costeaning, assays close to the surface ranging from 20 to 26 dwt. per ton.

▶ Work at the mine of Central Norseman Gold Corporation, Norseman, W. A., is

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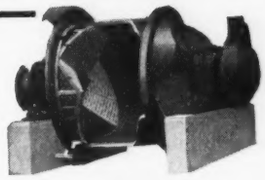

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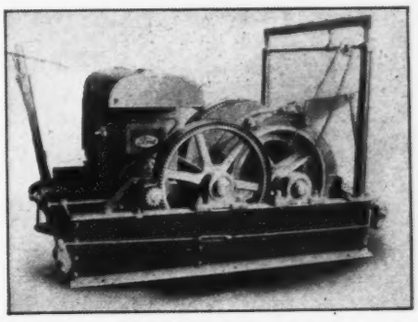

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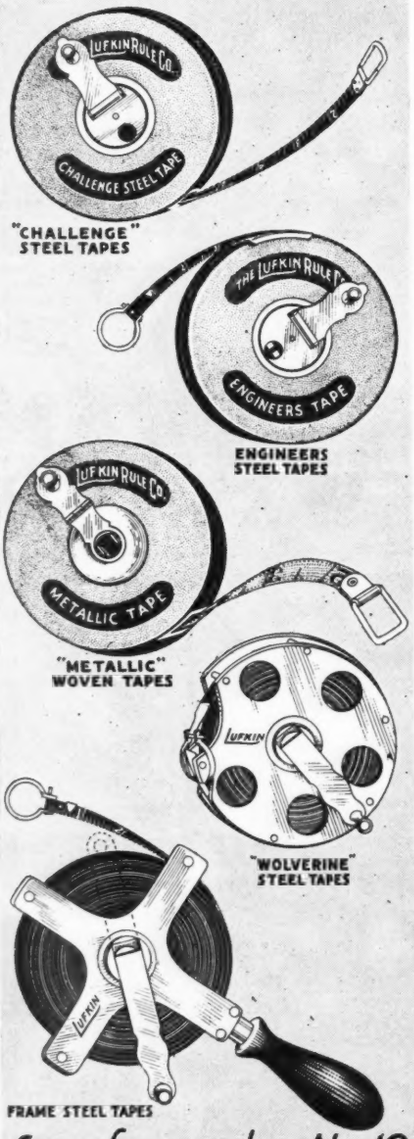

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▶AUSTRALIA

being directed toward the opening up of the deeper ore zone. Development along the strike has not yet proceeded sufficiently far to prove the case for repetition of the upper ore zone in depth.

▶The Moonlight Wiluna mine of Gold Fields Australian Development Company is responding well to development, ore reserves at Dec. 31 last totaling 409,000 short tons averaging 6.0 dwt. per ton. Gold produced totaled 22,085 oz. Antimony concentrates totaling 1,336 tons were shipped to Europe.

▶Big Bell Gold Mines, Ltd., has been granted a mining reservation on the Yilgarn gold field, where representatives of the company have been investigating low-grade properties, including the Corinthia mine.

▶Present capacity of the mill of Norseman Gold Mines, N. L., Norseman, W. A., about 7,000 short tons monthly, will be more than doubled by extensions now in progress and expected to be completed by the end of the year.

▶Ore reserves of Triton Gold Mines, N. L., Cue, W. A., increased by 70,000 tons during the half-year to March 31, now totaling 293,000 tons averaging 7.2 dwt. During the period, mill capacity was increased to 9,000 tons monthly, and costs have been reduced to 32s. (Australian) per ton from the previous figure of about 37s.

Victoria

▶The new dredge of Victoria Gold Dredging Company, Newstead, started work on July 9, and is now in routine operation. The dredge, of 175,000 cu. yd. monthly capacity, is situated in a rich agricultural area, and is designed to re-soil the area after working, and also to operate without stream pollution.

▶Two prospectors have made a rich strike of gold at Bonnie Doon, in the Mansfield district, in a belt of country which yielded good returns about 50 years ago.

Queensland

▶No. 7 level, at an approximate depth of 1,000 ft., is now being opened up by Mount Isa Mines, Ltd. It is expected that production from this level on a substantial scale will commence about the end of the year. The company recently announced the impending cessation of the shipment of zinc concentrates, unless there is a substantial rise in metal prices and reduction in overseas freights before the end of August, when present commitments terminate.

▶Tableland Tin, N. L., which is equipping a large tin-dredging area at Return Creek, near Mount Garnet, expects that its No. 1 dredge, which was taken over with the property and is being remodeled, will commence operating in October.

▶Mount Morgan, Ltd., during the year to June 30, treated 376,800 tons of sulphide ore and 306,243 tons of oxidized ore, for a recovery of 57,081 oz. of gold and 2,257 tons of copper. These figures represent increases of 17,500 oz. gold and 450 tons copper compared with the previous twelve months. The increase in gold production is largely attributable to the full-time operation of the oxidized ore treatment plant.

▶Mount Coolon Gold Mines, N. L., announces that ore in sight is expected to last until about the end of September. Since its incorporation in 1931, the company has paid £330,000 (Australian) in dividends.

New South Wales

▶Both North Broken Hill, Ltd., and Broken Hill South, Ltd., report increased tonnages treated for the year to June 30. Construction of North's new 12,000-ton mill is well advanced and operation is expected before the end of the year. At the Zinc Corporation property surface extensions and alterations are also nearing completion, and the new mill should be in operation before the close of 1938. The new main shaft has reached the 16th level (depth about 2,250 ft.) and a circular airshaft, 13½ ft. in diameter and to have a depth of 3,000 ft., is being sunk to serve the lower workings of the Zinc Corporation and also the adjoining New Broken Hill Consolidated mine. The main lode of the Zinc Corporation mine has just been proved by diamond drilling at the No. 14 (present lowest) level, to be 224 ft. wide, assaying 17.2 per cent lead, 3 oz. per ton silver, and 13.7 per cent zinc.

Tasmania

▶Treatment of ore at Mount Lyell has now reached the rate of over 1,000,000 tons annually, and grade continues to drop, the copper production for the nine months to June 30 being 8,684 tons from 748,050 tons of ore, a recovery of 1.16 per cent, compared with 1.46 per cent during the corresponding period of the previous year.

▶Operation of the mill of King Island Scheelite, N. L., commenced the last week of June. The company, which reopened an old mine which ceased operations during the post-War years owing to falling metal price, is at present treating 150 tons weekly, operating one shift per day. The ore, which past operations showed to contain about 1 per cent scheelite, is being treated by tabling followed by magnetic separation of the table concentrates.

▶Zinc production at the Risdon works of Electrolytic Zinc Company of Asia, Ltd., for the year ended June 30 was 69,718 tons, 364 tons less than in 1936-37. At the Rosebery mill of the company, in the West Coast district of Tasmania, production of zinc and lead concentrates increased by about 2,000 tons each, to 51,817 tons and 12,369 tons respectively.

Northern Australia

▶Two young prospectors, operating a tribute on the Wheal Doria lease at Tennant Creek, have raised 65 tons of ore in seven weeks, assaying over 5 oz. gold per ton. The total value approached £3,000 (Australian).

▶Rich surface showings at Attack Creek, which attracted attention some little time ago, have resulted in the acquirement of the area by Northern Territory Prospectors, N. L. Alluvial gold is being recovered by dry-blowing, and a reef, said to be 30 ft. wide, is now being opened up.

NEW BOOKS

MINERALS YEARBOOK 1938. *By the United States Bureau of Mines. Pp. x and 1339; chapters 70; figures 91. For sale by Superintendent of Documents, Washington, D. C. Price $2.*

THE 1938 VOLUME of this encyclopedia of information on the mineral industry culminates six consecutive years of progress since the Bureau of Mines inaugurated its new publication policy in 1933. Prior to that time it was customary to release the old Mineral Resources volumes some two or three years late. To meet the demand for prompt statistics, the Bureau undertook in 1933 to publish a single comprehensive volume with a minimum of delay and introduced the new series under the name of Minerals Yearbook.

Of the 70 chapters in the 1938 volume, 3 are devoted to general aspects or specialized phases of the industry, 34 to the metal industries, 25 to the nonmetallic industries, and 8 to the mineral fuels.

In the chapters devoted to metals one notes an interesting presentation of data pertinent to the lead and zinc tariff. The introduction to the chapter on copper contains a philosophical dissertation on the ills which beset the industry. Under the headings of manganese, tin, and chromite, much factual data can be found which have a bearing on deficiency minerals. Developments in the rare elements, from beryllium to zirconium, are discussed in a chapter on minor metals. Fifteen chapters are devoted to nonferrous metal mining in the States, and all but the one on Arizona contain final figures on production.

For the first time all statistics presented in the chapters devoted to nonmetallic minerals (other than fuels) are final. Phosphate rock has received special treatment in the current volume, a fact of considerable interest in view of the present discussion regarding domestic reserves of this raw material. The chapter on sulphur and pyrite contains a revised list of sulphuric acid plants in the United States.

The usual summaries of the mineral fuels are included also, the chapter on bituminous coal having been prepared by experts of the National Bituminous Coal Commission.

MINING DIRECTORY OF MINNESOTA, 1938. *By John J. Craig. Published by Mines Experiment Station, University of Minnesota, Minneapolis. Pp. 240.*

COMPLETENESS vies with compactness, as usual, in this handy little book, measuring 4¾x6¾ in. in dimensions. The present edition is the nineteenth. Its contents fall into five parts, thus: Part I, maps compiled by the Mines Experiment Station and corrected to May 1, 1938. These show mines, beneficiation plants, highways, and other topographical features. Part II gives a list of mines and properties that have shipped ore or are otherwise listed in the tax records. Part III contains a list of mining companies and holding organizations, and their officials, identified with Minnesota mining. Part IV is devoted to iron-ore mining statistics. Part V comprises a list, said to be incomplete, of men associated with the mining industry in Minnesota. The book is exceedingly useful.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. *Fifth Edition. Published by Lincoln Electric Company, Cleveland, Ohio. Pages 1012. Price $1.50 postpaid, in the United States; $2 elsewhere.*

WIDE IN ITS SCOPE, concisely written, and having 1,243 illustrations, the new Handbook is the complete arc-welding reference guide. Much new material has been added. Written especially for designers, engineers, welding supervisors, and operators, among others, it contains much data of interest to draftsmen, steel fabricators and erectors, foremen, cost estimators, maintenance managers, piping and pipe-line contractors and students of welding.

▼

PUBLICATIONS
RECEIVED

✦ *Annual Report of the Government Mining Engineer, Union of South Africa, 1937.* Department of Mines, Pretoria. Price 10s. 6.

✦ *Gesteinbohren (Rock Drilling).* Published by Demag A. G., Duisburg, Germany. Verlag Glückauf G.m.b.h., Essen. Pages 218. Price Rm. 2.80.

✦ *Mexico's Resources for Livelihood.* By Alejandro Carrillo. International Industrial Relations Institute. The Hague and New York. Pp. 34.

✦ *Gold and Poverty in South Africa.* By Max Yergan. International Industrial Relations Institute. The Hague and New York. Pp. 24.

✦ *Las Exportaciones Mineras en el Peru, 1937.* By Jorge Hohagen. Bulletin of the Cuerpo de Ingenieros de Minas del Peru. Lima. Pp. 396.

✦ *Preservation of Mining Timber.* By Mrs. M. Brown. Timber Research Laboratory, Transvaal Chamber of Mines, Johannesburg. Reference is made to the patented zinc sulphate Triolith process.

✦ *Investigation in Ore Dressing and Metallurgy, January to June, 1937.* Bulletin 785. Bureau of Mines, Ottawa. Pp. 158.

✦ *The Canadian Mineral Industry in 1937.* Reviews by the staff of the Bureau of Mines, Ottawa. Bulletin 791. Pp. 99. Price 25c.

✦ *48th Annual Report, Transvaal Chamber of Mines, 1937.* Box 809, Johannesburg, South Africa. Pp. 176.

✦ *Tripoli Deposits of Western Tennessee and Mississippi.* Geologic Bulletin No. 8, Tennessee Valley Authority, Knoxville, Tenn. Pp. 18.

✦ *Index to Annual Reports of the Minister of Mines of British Columbia.* For years 1874 to 1936, inclusive. Compiled by H. T. Nation. Pp. 510.

✦ *The Flotation Index.* Additional pages covering the year 1937 have been received from the Great Western Electro-Chemical Company, San Francisco, for the Index that it publishes.

✦ *State Regulations Pertaining to the Use of Internal-Combustion Engines in Coal and Metal Mines and in Tunnels.* By L. C. Ilsley and E. J. Gleim. Information Circular 7019, U. S. Bureau of Mines, Washington, D. C.

✦ *Earth Vibrations Caused by Mine Blasting, Progress Report 2.* By J. R. Thoenen and S. L. Windes. Report of Investigations 3407. U. S. Bureau of Mines, Washington, D. C. Pp. 46.

✦ *Geology and Mineral Resources of California.* Bulletin 115. State Division of Mines, Ferry Building, San Francisco, Calif. A bibliography for the years 1931 to 1936 inclusive, by Solon Shedd. Pp. 125.

✦ *Geology and Mineral Deposits of the Snowmass Mountain Area, Gunnison County, Colo.* U. S. Geological Survey Bulletin 884, by John W. Vanderwitt. Pp. 184. Price $1.

✦ *Geology and Ore Deposits of the Bayhorse Region, Custer County, Idaho.* U. S. Geological Survey Bulletin 877, by Clyde P. Ross. Pp. 161. Price $1.

✦ *Annual Report of the Quebec Bureau of Mines, 1936. Part A.* Mining Operations and Statistics. Hon. Onesime Gagnon, Minister, Quebec, Canada. Pp. 166.

✦ *Pressure Losses Resulting From Changes in Cross-Sectional Area in Air Ducts.* By Alonze P. Kratz and Julian R. Fellows, University of Illinois. Bulletin 52. Urbana, Ill. Pp. 58.

✦ *Phosphate Rock.* By George I. Whitlatch. Markets Circular No. 8. Tennessee Department of Conservation, Division of Geology, Nashville, Tenn. Pp. 35.

✦ *Petrologie des Nickelerzfeldes Kaulatunturi.* By Heikki Väyrynen. Geological Commission of Finland. Bulletin No. 116. Helsinki, Finland. Pp. 202, plus map.

✦ *The Pre-cambrian of Fennoscandia and South Africa.* By T. W. Scevers. *Transactions,* Geological Commission of Finland. Bulletin No. 119. Helsinki, Pp. 32.

✦ *The Valdez Creek Mining District, Alaska, in 1936.* By Ralph Tuck. U. S. Geological Survey Bulletin 897-B. Pp. 24. Price 5¢.

✦ *The Bureau of Mines and Mineral Utilization.* By John W. Finch. Information Circular 6996, U. S. Bureau of Mines, Washington, D. C. Pp. 6.

✦ *Natural Gas in Montana.* By E. S. Perry. Memoir No. 3. Montana Bureau of Mines and Geology and Montana School of Mines, Butte, Mont. Pp. 96.

PRODUCTION

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MASCOT is turning waste into PROFIT

At the zinc mining and concentrating operations of the Mascot (Tenn.) mine, "tailings", or waste product, following concentrate output, are conveyed by pipe lines to a tailing "pond". From this point the problem appeared complex, even though a ready market (low priced as it was) was found.

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EQUIPMENT NEWS

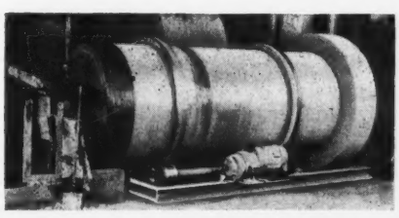
Utility Jig

A KNOCKDOWN TYPE JIG weighing 170 lb., suitable for many purposes, is announced by F. N. Bendelari, Joplin, Mo. The unit is designed to meet a demand for a less expensive, lighter-weight jig of useful capacity. On field tests for larger placer operations this jig

is said to handle three to five yards per hour and will save both fine and coated gold. The unit is said to be useful in gold mills in closed circuit with ball mill and classifier to handle 50 to 75 tons initial feed with 600 per cent circulating load to recover 65 per cent to 90 per cent of free gold ahead of other treatment. For other mineral concentrations the jig is said to handle feed up to 3/16 in. and in some cases up to $\frac{3}{8}$ in. The jig is convertible for right-hand or left-hand drive and either endflow or crossflow feed. The bed is 18x18 in.; height of unit is 38 in.; height to feed is 35 in., and the heaviest part weighs 47 lb.

Improved Classifier

AMONG OTHER recent improvements announced by Hardinge Company, Inc., York, Pa., in the Hardinge Counter-Current Classifier. The capacity is said to have been increased for a given size of classifier volume, by changing the shape of the spiral attached to the drum, which



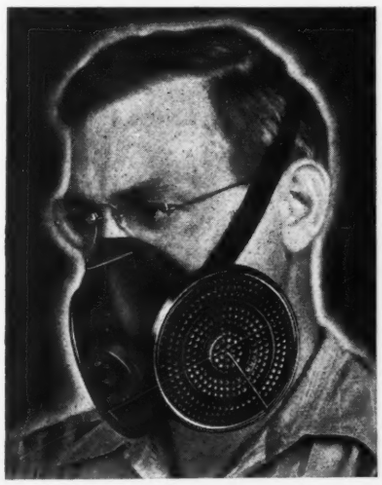
rolls the sands from the feed end to the oversize or discharge end. In decreasing the height of the spiral in the settling zone, and increasing it at the oversize end, the agitation was greatly reduced and this permitted handling of greater quantities of oversize. Thus, increased capacity of both finished product discharged, and oversize or sands delivered at the opposite end, is obtained.

Prevents Adherence of Weld Spatter

A NEW MATERIAL (Glyptal No. 1294) has been announced by General Electric Company, Schenectady, N. Y., for the prevention of the adhesion of weld spatter to metals which are to be welded. This material, which can be used without harm on any metal surface, including polished stainless steel, will not produce carbon to make the weld hard or brittle, nor will it reduce ductility. Likewise, it will not give off smoke to fog up the atmosphere and it will not form gas pockets or cause the weld to be porous.

Respirator

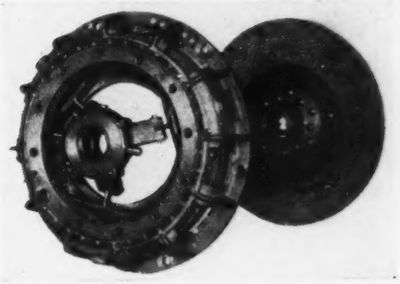
A NEW dual-disk respirator for protection against Type A, or nuisance, dusts, which employs unusually inexpensive throw-away filters, was recently developed by Willson Products, Inc., 260 Thorn St., Reading, Pa. This respira-



tor is approved by the United States Bureau of Mines. Inasmuch as only one filter is needed for each holder, and either side of the filter may face outwardly, the wearer is said to have no difficulty in making filter changes when needed, and has assured protection. The dual-disk filters provide 28 sq.in. of filtering surface, offering the advantage of very little resistance to breathing.

New Clutch Feature

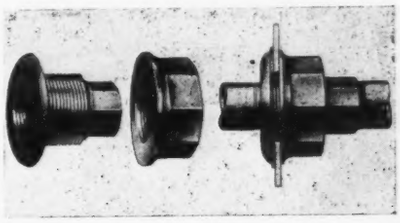
THE ROCKFORD Drilling Machine Division of Borg-Warner Corporation, 301 Catherine St., Rockford, Ill., announces a new Roller Cam feature of the Rock-



ford Over-Center Clutch. This improvement is said to make clutch operation extremely easy and exert heavy pressure symmetrically over the entire clutch face and also contribute substantially to long-time operation without adjustment. Hardened and ground rollers bear upon hard steel inserts in pressure plate and on a hardened adjusting ring plate.

Quick Pipe Connections to Tanks

THE AMERICAN Pipe & Steel Corporation, 230 Date Ave., Alhambra, Calif., announces a unique device whereby pipes can be connected to either the inside or outside of a tank. The flange body,

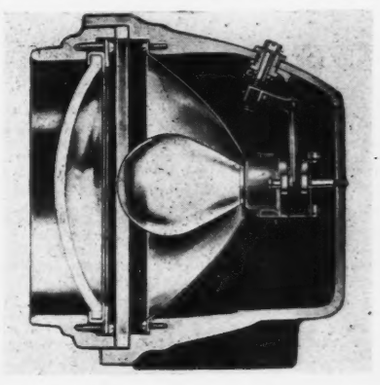


shown herewith, is tapped at both ends and threaded outside, and is inserted through a hole of proper size from the inside of the tank. The outside piece, similar to an eight-sided nut with one face flanged out and finished, is attached by means of a left-hand thread. When used in connection with a Unitank Flange Cutter, the manufacturer says a 6-in. flange can be installed in three minutes and smaller sizes in less time.

New Headlight Mechanism

OHIO BRASS COMPANY, Mansfield, Ohio, announces new incandescent mine headlight developments facilitating accurate focus adjustment.

The Type MB headlight for gathering-



A new and improved Exide Water Cell Filler, is announced by the Electric Storage Battery Company, Philadelphia. The new filler, designated as Type LV, is said to eliminate the guesswork from the job, and simplifies and speeds up the operation of adding water, at the same time permitting the job to be done neatly. It insures, also, filling to the proper level. The filler is known as a "single-circuit" filler and current is obtained from the battery being filled to operate a light or buzzer attached near the handle of the filler.

locomotives is now available with externally operated focusing mechanism with medium screw base, push-pull focusing mechanism with medium screw base, and medium pre-focus base. Type MSS headlight for main haulage is also available with these three focusing arrangements. Type MS headlight and the new Type MF explosion-proof headlight are furnished with push-pull and pre-focus designs. The externally operated focusing mechanism eliminates opening the casing in any way for adjusting the beam. All headlights are now furnished with the new corrosion-resistant Alzak reflector. This reflector is said not to chip, crack, or peel and is easily cleaned.

Welded Pillow Blocks

SHAFER Bearing Corporation, 35 East Wacker Drive, Chicago, announces a new line of Standard Duty roller-bearing pillow blocks with a new type of welded-steel housing construction. These pillow blocks are available in sizes from $1\frac{7}{16}$-in. to $8\frac{1}{2}$-in. bore. The manufacturer's concave roller design is said to provide generous capacity for radial, thrust, and combined radial-thrust loads, together with integral self-alignment. Automatic compensation is provided for misalignment or shaft deflection up to $1\frac{1}{2}$ deg. each side of center. Both fixed and expansion types of pillow block are now available.

BULLETINS

Foam-Liquid Slime Pump. The Bingham Pump Company, 705 East Main St., Portland, Ore. Bulletin No. 34 describes the manufacturer's new pump for handling flotation concentrates and foaming liquids. Pp. 4.

Pneumatic Products. C. A. Norgren Co., Inc., Denver, Colo. Catalog illustrating valves, regulators, and air-hose connections. Pp. 23.

Eye Protection. American Optical Co., Southbridge, Mass. Folder TL, 135A is entitled "How to Fit Goggles to Workers" and contains instructive illustrations. Pp. 4.

Crushing Rolls. Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Bulletin 1815-D describes and illustrates the company's line of crushing rolls. Pp. 7. **Machinery for Complete Crushing Plants.** Bulletin 1473A illustrates and describes the manufacturer's variety of machinery for crushing plants. Information on power, electrical, transmission, and auxiliary equipment is also included. Pp. 32.

Variable - Speed - Control Equipment. Reeves Pulley Co., Columbus, Ind. Catalog G-384 contains the manufacturer's first presentation of the company's Variable Speed Transmission, Variable Motor Pulley, and Motordrive in one book. The $8\frac{1}{2}$x11-in. loose-leaf book is profusely illustrated and many pages are devoted to engineering data of the three control units. Pp. 124.

Load Lugger. Brooks Equipment & Manufacturing Co., Knoxville, Tenn. Folder describes and illustrates a detachable truck bucket for time saving when hand-shoveling loose aggregate. Pp. 4.

Industrial Lighting Fixtures. The Pyle-National Co., 1334 North Kostner Ave., Chicago, Ill. Bulletin 1125 describes and illustrates lighting fixtures for industrial purposes. Pp. 11.

Frequency Recorders and Indicators. Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia, Pa. Catalog N-57-161 describes and illustrates equipment for frequency measurement and for frequency load control. Pp. 20.

Valves. Homestead Valve Manufacturing Co., Coraopolis, Pa. Reference book No. 38 illustrates and describes the company's valves for various industrial uses. Pp. 48.

Automatic Drifter. Sullivan Machinery Co., Claremont, N. H. Bulletin 87-U describes and illustrates features of the company's automatic drifter known as the "Adjust-O-Feed." Pp. 4.

Lifting Magnets. Dings Magnetic Separator Co., Milwaukee, Wis. Catalog 22 illustrates and describes the manufacturer's high-intensity lifting magnets and types of magnetic separators. Pp. 16.

Cadmium Plating. E. I. du Pont de Nemours & Co., Wilmington, Del. The company has issued a technical service manual on Cadalyte 138, that gives a table of costs and time required for specified deposits. Pp. 11.

Mill Equipment Catalog. Denver Equipment Co., Denver, Colo. Bulletin 3,800 is a handy, pocket-size, loose-leaf ring binder catalog describing and illustrating the manufacturer's equipment for metallurgical plants. Tables and flowsheet of many plants are included. Pp. 200.

Jackhamer. Ingersoll-Rand Company, 11 Broadway, New York, N. Y. Form 2433 describes and illustrates the manufacturer's new JA-35 Jackhamer for light drill work. Pp. 7.

Refractory Products. Johns-Manville, 22 East 40 St., New York, N. Y. Form DS Series 700 is an engineering data book containing a comprehensive table of types of heating equipment used in the various industries. The parts requiring refractory cement and the specific product for the job are described. Pp. 20.

Steam Turbines. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Bulletin 2137 describes and illustrates Type C general-purpose turbines ranging from 5 to 500 hp. Pp. 12.

Pillow Blocks. Shafer Bearing Corporation, 35 East Wacker Drive, Chicago, Ill. Bulletin 521 describes and illustrates the company's Super-Sealed pillar block. Pp. 3.

Turbo-Generator. The Pyle-National Co., 1334-58 North Kostner Ave., Chicago, Ill. Bulletin 206 describes the manufacturer's Type MC-5 turbo-generator. Pp. 2.

Welding Electrodes. Harnischfeger Corporation, Milwaukee, Wis. Bulletin R-5 contains complete information and many illustrations on the company's Smootharc Welding Electrodes. Pp. 27.

Fireclay Brick. Barbison Walker Refractories Co., Pittsburgh, Pa. Folder describes features of the Alamo and Varnon fireclay brick for industrial use. Pp. 8.

Pipe Repair. A. R. Dresser Manufacturing Co., Bradford, Pa. Form 382A is a $8\frac{1}{2}$x11-in. booklet entitled "How to Join and Repair Pipe the Quick, Easy, Permanent Way." Pp. 12.

Seismic Prospecting Apparatus. Geophysical Instrument Co., Washington, D. C. Circular "9" describes and illustrates a newly developed apparatus for determining underground conditions prior to drilling and excavation. Pp. 4.

Jaw Crusher. Traylor Engineering & Manufacturing Co., Allentown, Pa. Bulletin 1105 describes and illustrates features of the Type H Blake jaw crusher. Pp. 13.

Regulators. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Catalog section 31-260 describes features of the Silverstat regulators for automatic voltage control of small a.c. and d.c. generators. Pp. 12.

Rotary Positive Blowers. Roots Connersville Blower Corporation, Connersville, Ind. Bulletin 21 B-19 describes the manufacturer's Victor Acme rotary blowers for commercial and industrial use. Pp. 8.

Corrosion Resistance. Mutual Chemical Co. of America, 270 Madison Ave., New York, N. Y., has issued a small folder entitled "Chromium Chemicals as Corrosion Inhibitors," which briefly summarizes its studies and experience in the use of chromium chemicals for the purpose of inhibiting corrosion. Pp. 8.

Mine Locomotive. General Electric Co., Schenectady, N. Y. Leaflet GEA-2865 describes a standard 10-ton trolley type mine locomotive. P. 1. **Headlight Equipment,** GEA-2640A. Pp. 4. **Thyratron Resistance-Welder Controls.** GEA-2791A. Pp. 4. **Welding Electrode** for cast-iron welding. GEA-2966. Pp. 1. **Brake Motor.** GEA-2026A, data on operating characteristics and application of their brake motor. Pp. 4. **Controllers for Synchronous Motors.** GEA-1724A describes complete line of controllers for sychronous motors. Pp. 11. **Photoelectric Relay for Automatic Light Control.** GEA-2679A describes advantages of automatic control of lighting. Pp. 6. **Manual Motor-Starting Switch.** GEA-2234B describes a small hand-operated starting switch which incorporates positive overload protection. Pp. 4. **Locking Device for Mine Locomotive.** GEA-2625 describes a brake-screw safety device to positively lock the brake rigging. Pp. 2. **Arc Welders.** 1750D describes Type WK alternating-current arc welders. Pp. 7. **Limit Switch.** GEA-2907 leaflet describes a new oil-proof switch for snap action. Pp. 2. **Oilproof Push Button Switch.** GEA-2408. Pp. 2.

Vibrating Screen. The Deister Concentrator Co., Fort Wayne, Ind. Bulletin 14-G describes and illustrates various industrial uses of the company's Model C, Leahy heavy-duty No-blind vibrating screen. Pp. 20.

Aerial Tramways in the Metal-Mining Industry—II*

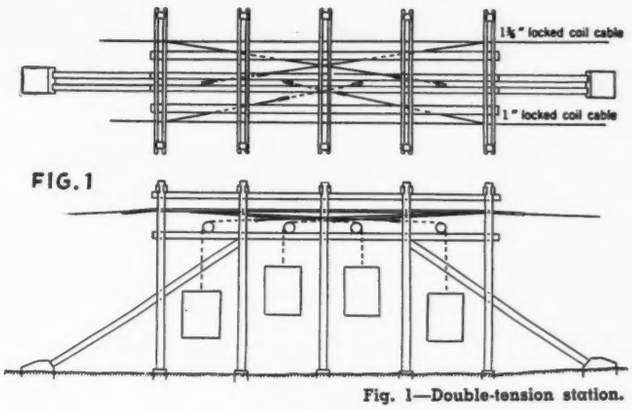
THE THREE FACTORS that determine the capacity of a tram are the capacity of the individual carriers, the spacing of the carriers, and the speed of the traction cable. Carriers having a capacity of 1,500 lb. or more cause excessive wear on the track cables, due to severe bending stresses caused by the rolling load, which is usually carried on two wheels. In the heavy-duty trams, these bending stresses have been reduced to a great extent by using carriers with four wheels, thus distributing the load over four points on the track cable instead of two. Extremely close spacing and high rope speeds are objectionable because of the difficulties involved in handling the carriers at the terminals. With trams that operate automatically the rope speed should be less than the highest speed of hand-operated trams, but the spacing may be such that the carriers enter and leave their terminals at the rate of four or five a minute. With hand-operated trams, the rope speed should not exceed 600 ft. a minute and the rate at which the carriers enter and leave the terminals should not exceed three a minute. Twenty tons an hour is about the low economic limit for tramways of the double-rope continuous type.

Cable Anchorages, Tension, and Anchorage Stations—The general practice in tramway construction is to anchor one end of a track cable in concrete or to a suitably constructed anchor station, and to secure the desired tension by suspending a weight at a tension station or at one of the terminals. With tramways up to 5,000 ft. long, cables can be anchored at one terminal and weights suspended at the other. In the installations of longer tramways, tension stations or anchor stations or both must be used. Fig. 1 shows a double-tension station and Fig. 2 a double-anchor station. The number and location of these stations depend on the length of the tram and the topography of the region in which it is built.

Cables are supported by towers at intermediate stations along the line wherever necessary. For tramways of moderate capacity, these towers generally have but one point of support. The cables lie loosely in saddles and can slide forward and back as the load varies.

Some tramway engineers anchor both ends of the track cables. This practice undoubtedly has advantages, especially on lines where great variations in sag may be objectionable. In weighted spans the tension remains constant but the sag varies with the load. With anchored spans the sag has much less variation, but the tension increases in nearly direct proportion with the load. Because of this, cables to take care of variations in anchored spans require a heavier track load than is required on a weighted span for the same purpose.

Where towers are required on concave profiles, as in broad valleys, the cables are likely to lift out of the saddles of the lower towers when that part of the line is unloaded. If the cables are anchored, this is less likely to happen than if they are weighted. On such profiles excessive variation in sag due to variation in load on weighted spans can be eliminated by blocking up under the weight boxes to within about a foot of their position when the line is normally loaded. Then, if the line is unloaded, the weights rest upon the blocking and only a slight variation in sag takes place. This practice provides, to a great extent, the favorable



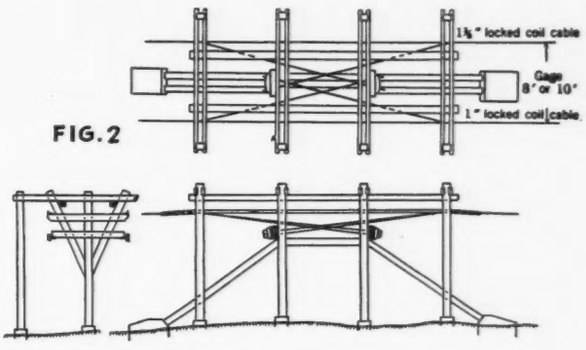
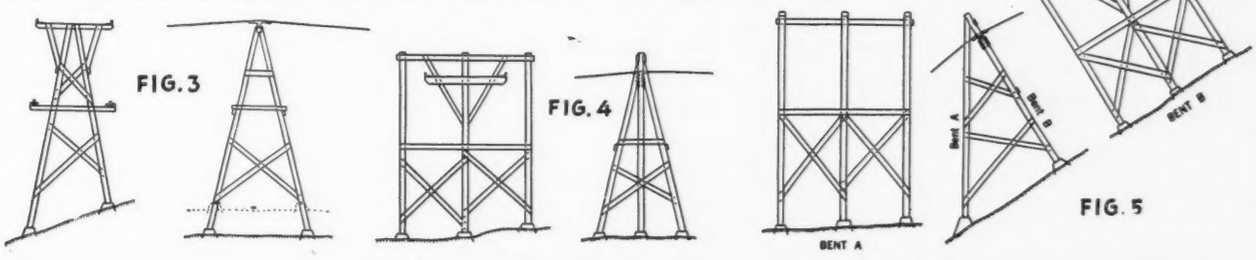


Fig. 1—Double-tension station. Fig. 2—Double-anchor station

Fig. 3—Pyramid tower. Fig. 4—Through tower. Fig. 5—Hillside tower, through type



* The first installment appeared in the August issue.

characteristics of an anchored span and has the advantage that the tension does not become excessive if the line is overloaded.

Types of Towers—The pyramid tower (Fig. 3) and the through tower (Fig. 4) are the two types most generally used. The pyramid tower is economical of material and very satisfactory for steel construction. It is not so satisfacory for timber construction, as there is not sufficient area at the top for fastening the saddle beam properly.

The through tower is very sturdy and is well adapted to timber construction but requires almost twice as much material per foot of height as the pyramid tower. For heavy-duty trams it is built with nine posts, but for lighter lines the two outside center posts can be left out.

The hillside tower (Fig. 5) is an adaptation of either the pyramid or the through tower for use on steep hillsides or where the inclination of the track cables is very steep. The posts on the downhill side are perpendicular, while the posts on the uphill side are on a line with or in a line a little outside of one normal to the cables.

On profiles that are concave, the towers will be spaced far apart, whereas on profiles that are convex, such as on mountain ridges, the towers must be spaced closely.

The difference in the slope of the cable on opposite sides of a tower at the point of contact with the saddle is known as the deflection angle at that tower. This angle should not be greater than 6 to 8 deg. If the deflection is greater than 8 deg., the wear on the cables becomes excessive and either a rail structure or extra towers should be used.

Rail Structures—Rail structures are from 15 to as much as 100 ft. long. The cables are supported at points from 5 to 10 ft. apart, constructed on the arc of a circular curve. A curved rail is fastened just above the cable for the carriers to move on. This saves excessive wear on the cables and provides a smooth circular track for the load to move on instead of a series of short chords. Rail structures can often be used to advantage as anchor and tension stations.

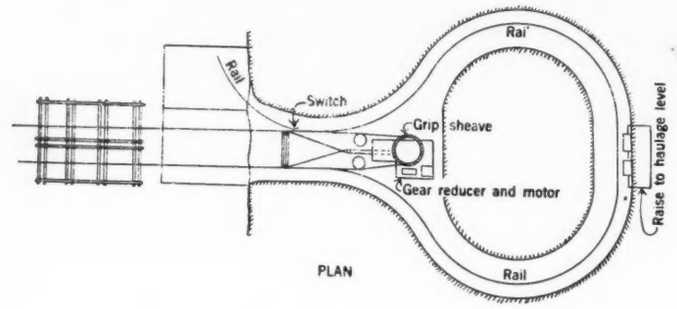
Terminals and Operating Machinery—Terminals (Figs. 6 and 7) must be provided with bins for loading and for discharging material. Where mine supplies are to be transported, sufficient floor space and switches must be provided. The carriers run on rails at the terminals, and by means of a simple throw switch they can be run on side tracks for loading heavy materials such as timber and rails. The brakes and the machinery that operates the traction cable are generally located at the loading terminal. The machinery consists principally of a sheave, around which the traction cable runs, geared or belted to a motor. The motor acts either as a drive or a control, or both.

If the difference in elevation of terminals is not great, a smooth sheave gage would be advisable, as it would eliminate, to a great extent, the possibility that might arise of the cables and carriers swinging together during severe storms.

Construction Materials—Steel and timber both are satisfactory for tramway structures. Steel lends itself more naturally to complicated designs. It also eliminates the fire hazard, and has numerous other advantages. Present tendencies are to use steel almost entirely, except in isolated localities. The first cost is from 40 to 60 per cent greater than for timber, but after a structure is once built it requires practically no attention.

(*To be continued*)

Excerpted from U. S. Bureau of Mines Information Circular 6948, entitled "Aerial Tramways in the Mining Industry," Part I. By O. H. Metzger.



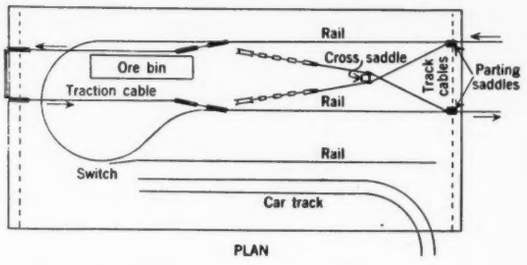
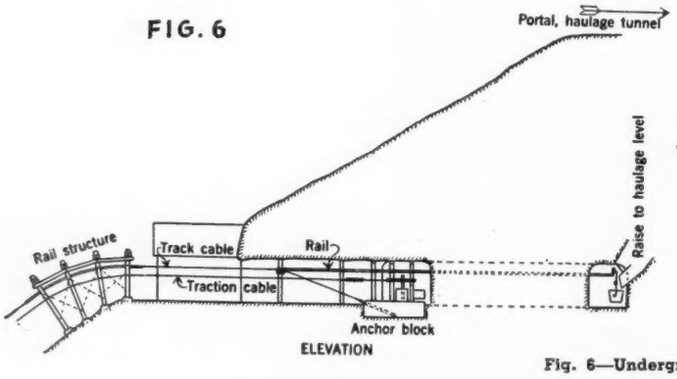


FIG. 6



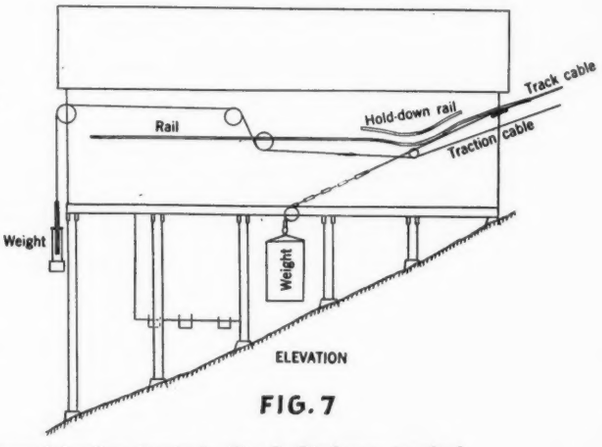


FIG. 7

Fig. 6—Underground loading terminal. Fig. 7—Discharge terminal